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Publication ... February 1932

Construction Methods

Pipe-Pile Foundation for Western Hills Viaduct, Cincinnati

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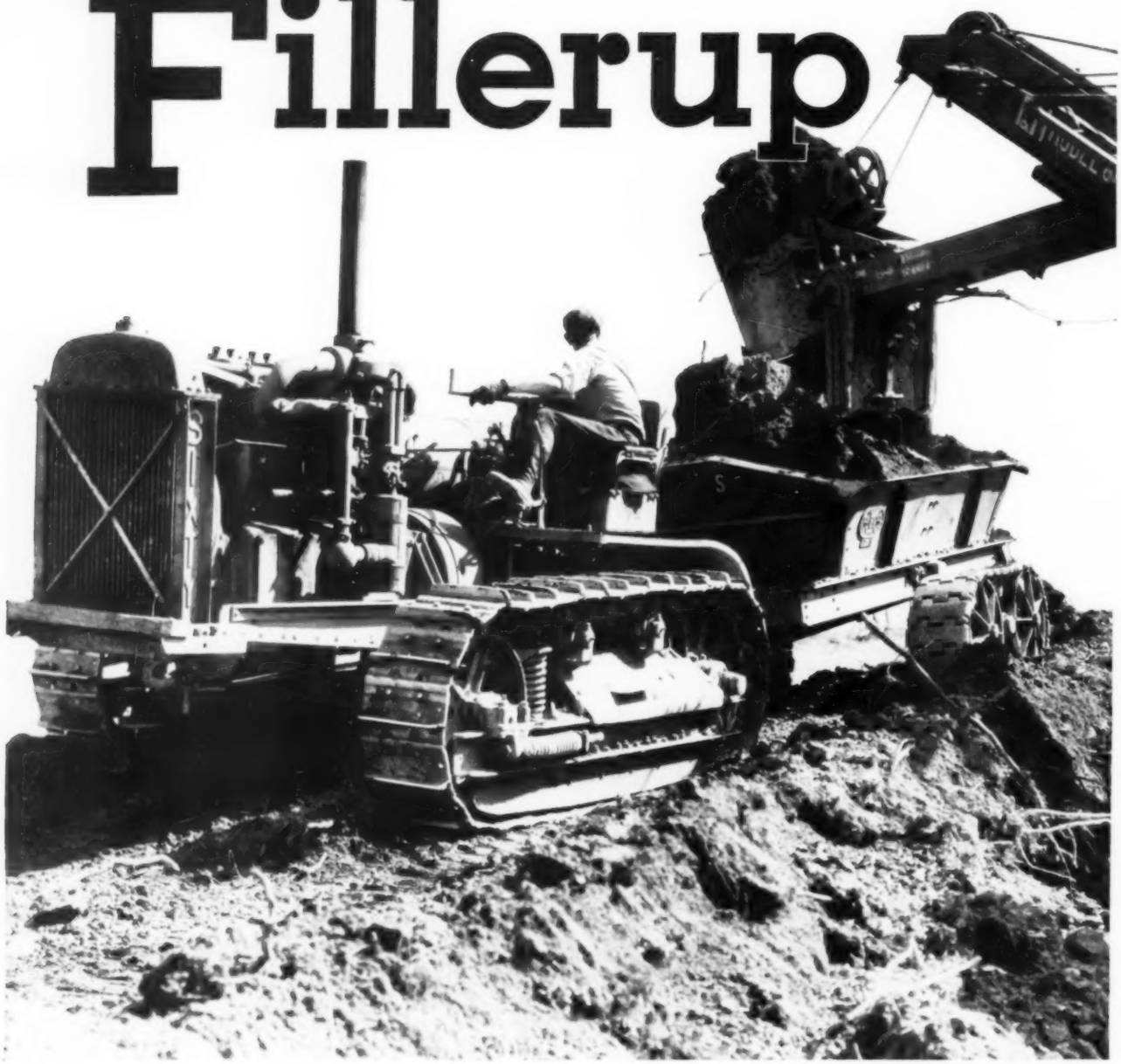

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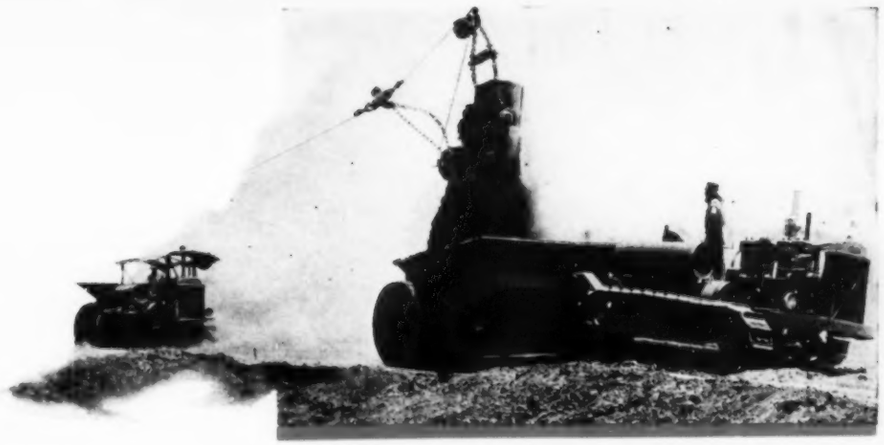
The Editor Notes -



The Road Builders Carry On

STAGED during a period of nationwide contraction in the volume of construction of all types, last month's annual convention and show of the American Road Builders' Association at Detroit furnished conclusive evidence of the virility of that organization and the industry it serves. It is true that, in number and variety of exhibits and in attendance by engineers and contractors, this year's meeting fell somewhat short of the marks set during more prosperous times. Nevertheless, a highly creditable and courageous showing was made —one that leaves no doubt of a stout-hearted determination on the part of the road builder to carry on, regardless of difficulties that may beset his path.

The Show

The municipal airport building at Detroit, with its large expanse of unobstructed, naturally lighted floor space at ground level, was well adapted to handling and displaying the road-building equipment and materials which the manufacturers had to offer. While comparatively little of the "heavy" machinery—power shovels, cranes, paving mixers, tractors and graders—associated with former road shows was featured, the exhibit was interesting and well presented. As was to have been expected in the capital city of the automotive industry, motor trucks and gasoline power units predominated, while materials of construction, particularly of bituminous types which have made such decided headway during the past year, were well represented at the show.

Committee Reports

Never before has the association offered such a wealth of practical information as was presented in its program of papers and committee reports. The scope was broad enough to appeal to all of the various interests concerned with highway development, for the subjects discussed included administration and finance, location and surveying, design, construction, maintenance, equipment and traffic. Separate group meetings considered the specialized problems of city engineers, county engineers, asphalt paving technologists and contractors. For any one desirous of keeping abreast of road-building developments this year's committee reports, many of them embodying the results of country-wide investigation, constitute a useful manual of approved current practice, setting forth details of recommended procedure in building or maintaining roads of various types.

Unfortunately the audiences that heard these committee reports at the several sessions generally were much smaller than the importance of the subjects and the excellence of their contents warranted. The material, however, will appear in the association's proceedings and through that medium merits wide distribution and careful study. In supplying to its membership timely, reliable, detailed information on approved highway practices, the American Road Builders' Association is performing one of its most useful functions.

CONSTRUCTION METHODS

A monthly review of modern construction practice and equipment

ROBERT K. TOMLIN, *Editor*

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Tunnel Reconstruction

The extensive tunnel enlargement and reconstruction operations involved in the main-line betterment program of the Chesapeake & Ohio Railway forms the subject of a series of articles, the first of which appears on p. 34 of this issue.

Standard Grading for Face Brick

FACE brick has joined the growing list of building materials which are being sold under grading rules that protect both the buyer and the seller. At its recent annual meeting, the American Face Brick Association formally adopted standard grading rules that had been in process of preparation for more than a year and that will henceforth be used as the basis on which face brick are sold.

Four classifications are given in the rules, namely, Uniform Shade, Mingled Shade, Substandard, and Cull. All first quality brick are placed in the first two classifications, which have stringent requirements as to dimensional variations, chippage, color and warpage.

The rules as adopted are based upon the standardized sizes of brick which were established in 1923.

Requirements as to variation in maximum and minimum dimensions protect the user against too great size variation. The small permissible variation in maximum and minimum dimensions for any given color insure brick that lay up well in the walls of buildings and other structures.

Progress at Hoover Dam

Before large-scale operations could proceed on the $49,000,000 contract for the Hoover Dam across the Colorado River, awarded last March to Six Companies, Inc., an extensive program of preliminary construction had to be completed to house the personnel of the contractor's organization and the U. S. Bureau of Reclamation. In effect, it became necessary to create in the Nevada desert a fair-sized city, with houses, streets, sewers, water supply and other municipal facilities. The story of the building of Boulder City, Nev., begins in this issue.

But Don't Forget to *Tell* Them!

EVEN in these thin times some concerns are earning more net than they were a year ago. Of course, it's no easy stunt; neither is there any recipe that will guarantee such a result in any specific case. But it's good to know that it can be done.

The head of one firm which has thus increased its earnings without benefit of pay-cuts or lay-offs attributes its accomplishment to several factors, all essential: quick write-off of inevitable losses, lower production costs, more intensive sales effort and, most important of all, a thorough study of its markets to develop new products and new uses for old products that fit the need of the hour.

This executive has based his management on his faith that it is more effective to develop new products than to try to force an old line on a changing market.

Many other manufacturers are writing this principle into their 1932 plans, although not all of them will be able to realize on it so immediately as has this one. But right now some of them are laying the foundations for leadership during the next few years. It is a tradition of business that out of each depression arise by survival the leaders of the next prosperous period; and their rise, more likely than not, results from intelligent fitting of their products to the needs of their markets plus an aggressive policy of selling and advertising to tell their fields just what they have to offer.

After all it's not what the *maker* knows about his product that sells it; it's what the *prospective user* knows.

Industrial journals such as *Construction Methods* serve the double purpose of keeping the field abreast of modern needs and modern methods and of providing for the manufacturer the most direct and economical channel through which to tell that field why it needs his products or his service.

Make what they really need and then tell them about it over and over again. On this simple principle most of the successful American industries have been founded.

Willard Chevalier

Publishing Director.

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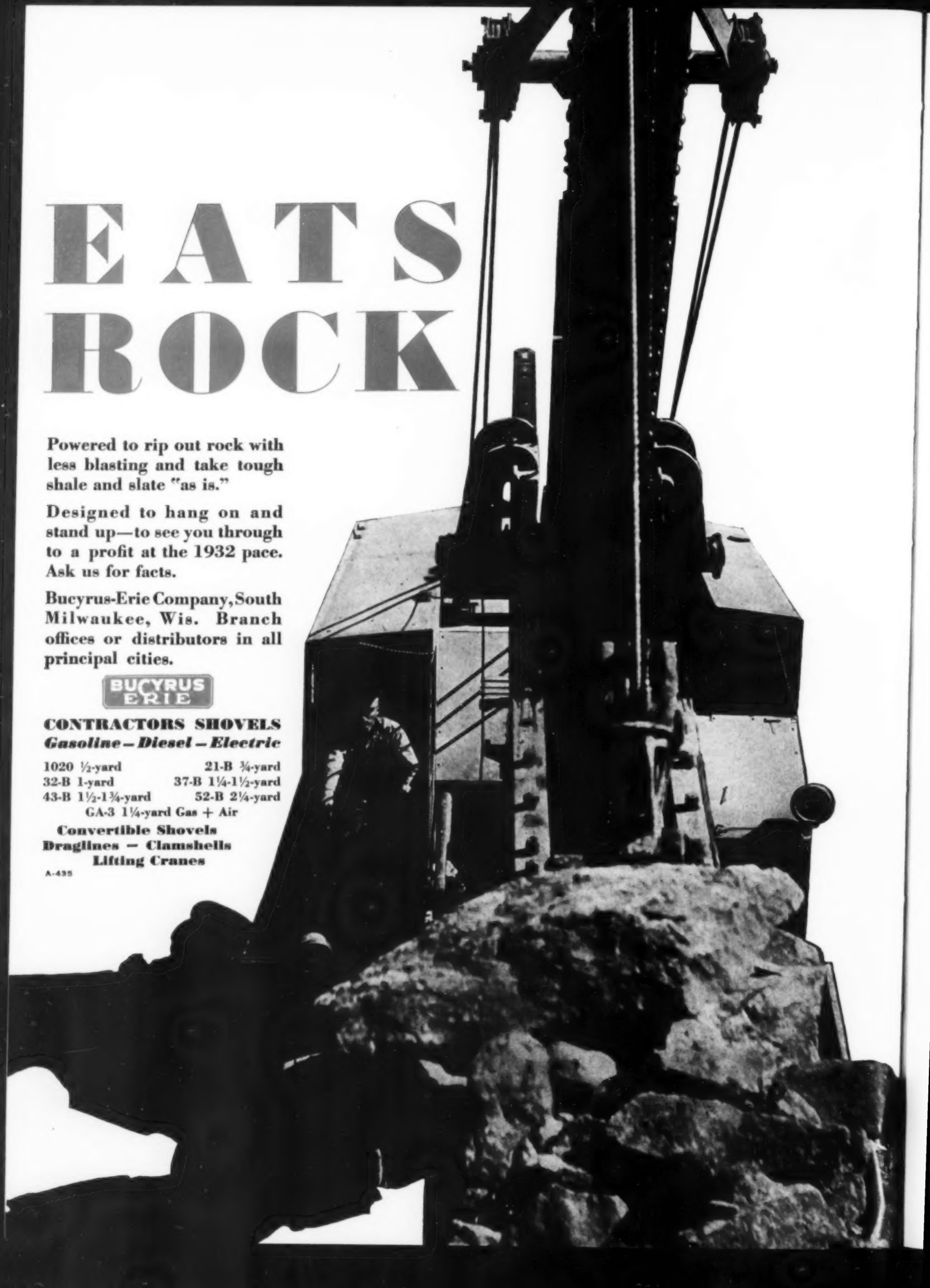

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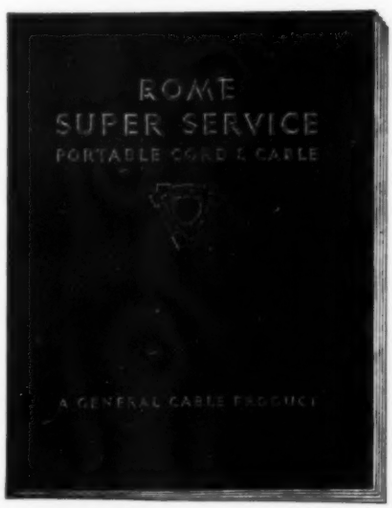

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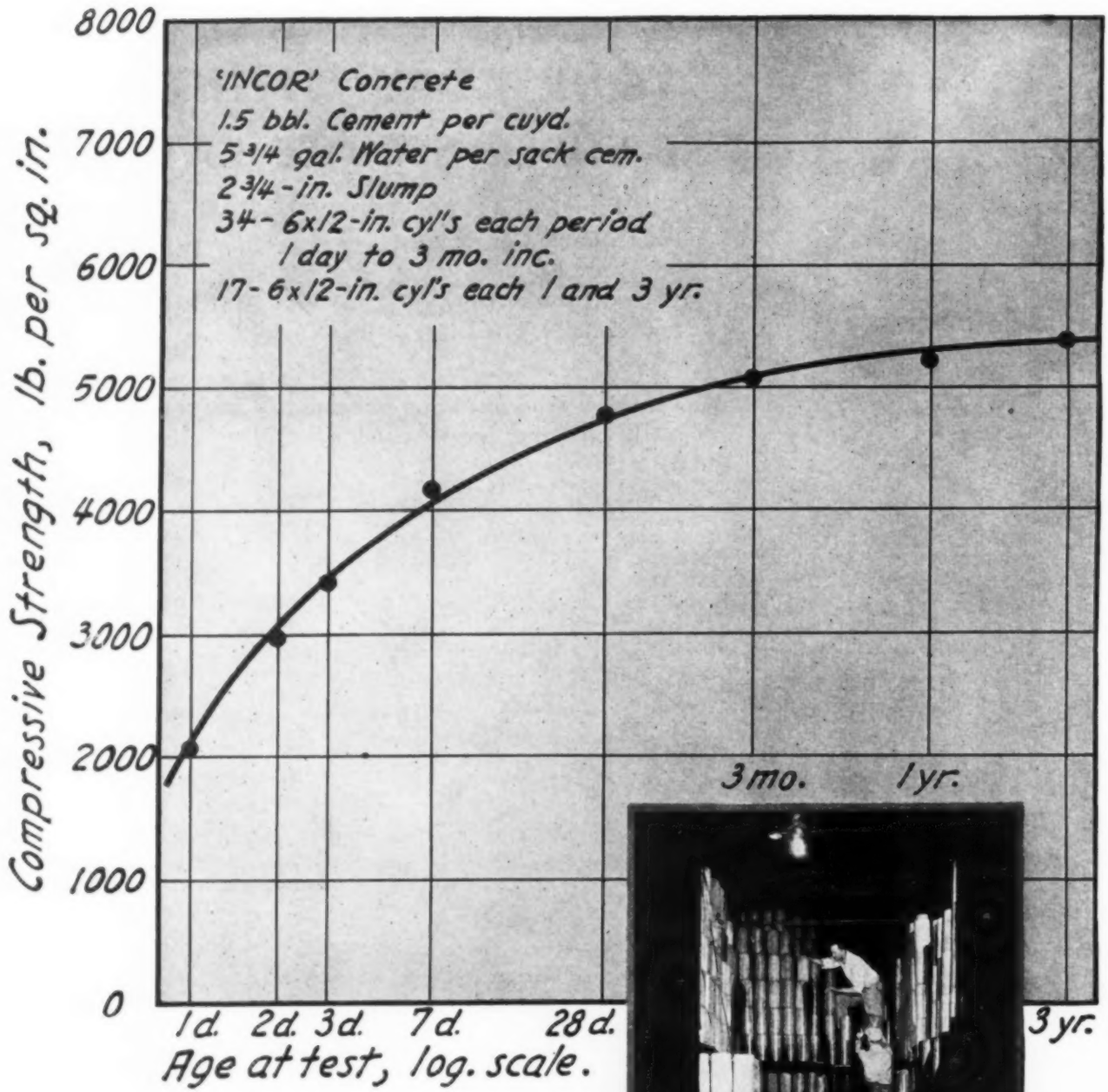

THE *LABORATORY* RECORD. (Above) The 'Incor' Concrete strength curve as established by 238 concrete cylinders tested to destruction at the periods indicated.

(Right) The "Moist-room" in which thousands of test cylinders and beams are cured. On the floor is a humidifier to insure saturated atmosphere at all times, typical evidence of the exacting care used in 'Incor' research.

the highways tell the same story

A summary of the tests described in these pages during the past six months

UNDER some of the heaviest traffic of the Chicago Loop is a piece of 'Incor' concrete laid on a cold October day in 1928.

That slab, in contrast to the surrounding pavement laid the same day, is still in almost perfect condition. Its unblemished surface has been the subject of special comment. Cores drilled from it at three years developed an average ultimate strength of 8567 pounds per square inch . . .

A typical 'Incor' result. Similar results are reported from scores of jobs throughout the country paved during the last five years. Several of them have been described on these pages. This cement, first used in cases of emergency where the time factor was paramount, has gradually come to be recognized as not only a high *early* strength, but also an exceptional high *ultimate* strength, cement.

In other words, the huge savings to merchants and motorists brought about by 'Incor's elimination of detours *are accompanied by an actual improvement in the quality of the concrete.*

THE *HIGHWAY* RECORD. Lifting a 6-inch 'Incor' core out of its hole. Hundreds of such cores drilled from 'Incor' pavements during the past five years, and tested to destruction, provide a record of toughness and ultimate strength unique in the history of Portland Cement.

The Basis of its Quality

This 'Incor' quality begins with the first step of manufacture. The best of materials, the best of apparatus, the best of technical talent is used in its production.

Intensive research work is also constantly being carried on. A part of this work which is of especial interest, is the cylinder tests, in which thousands of concrete cylinders, from 8 hours to 3 years of age, have been tested to destruction.

On the opposite page the result of one series of these tests is plotted on a single curve. They foreshadowed and now confirm the record of the highway concrete itself as revealed by the core tests.

In other words, the laboratory and the highways tell the same story, which is: *That 'Incor' concrete attains service strength within 24 hours, and adds to that strength in a consistently rising curve until after years of service it achieves a toughness and ultimate strength unique among Portland cements.*

These remarkable results are understandable when it is remembered that the high-early and high-ultimate strengths of 'Incor' are both achieved by the same means —not by admixtures or increased proportions of cement— but by the double-burning of the original product.

The way in which double-burning achieves these results is simple enough. All Portland cement, as you know, is composed of *tri*-calcium silicates and *di*-calcium silicates in varying proportions. The tri-silicates are active, the di-silicates sluggish.

In ordinary single-burned Portland cement the ratio of tri-silicates to di-silicates is 5 to 4. In 'Incor', because of double-burning, it is 8 to 1.

Double-burning is an exclusive 'Incor'* feature.

*Reg. U. S. Pat. Off

'INCOR' *24-Hour Cement*

MANUFACTURED BY THE 'DOUBLE BURNING' PROCESS

'INCOR' is made by the producers of Lone Star Cement, subsidiaries of International Cement Corporation, under Patent Nos. 1,700,032 & 1,700,033

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BARBER-GREENE conveyors not only speed up the job, and cut down the costs, but do the dirty work. Here we see them handling muck. A slow and expensive task if done entirely by hand.

On the next job they may be handling cement, or aggregate. They may be used between the mixer and forms pouring concrete (delivering it without segregation), possibly handling brick or tile, in any case saving money. Barber-Greenes are built in interchangeable sections. They can be lengthened or shortened on the job.

They can be used in tandem or singly. A contractor rarely has a job that would not cost less with one or more Barber-Greenes as standard equipment, for elevating or transporting his material. Their versatility makes them almost indispensable.

We maintain a department for the sole purpose of helping you solve your material handling problems the fastest and most inexpensive way. Its services are at your disposal. No obligation.

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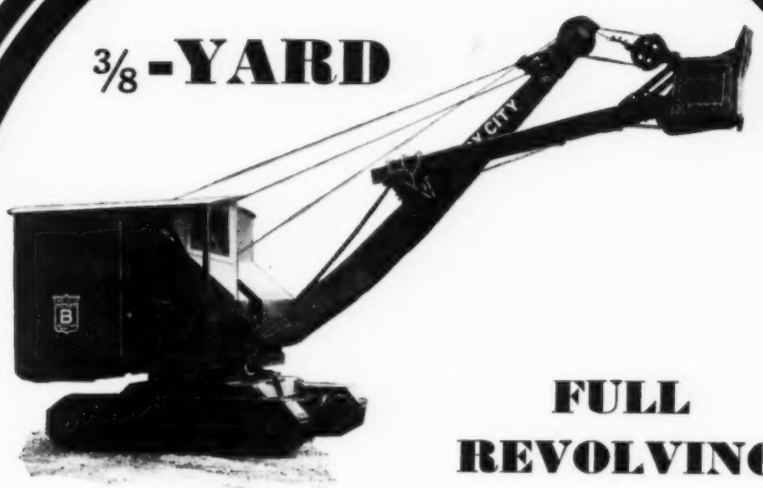
BAY CITY

MODEL - B

HUSKY

3/8 - YARD



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E-Z CLUTCH CONTROL	SHOVEL
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FAST SPEEDS	HOE
8-INCH CENTER POST	DRAGLINE
WIDE SWING CIRCLE	SKIMMER
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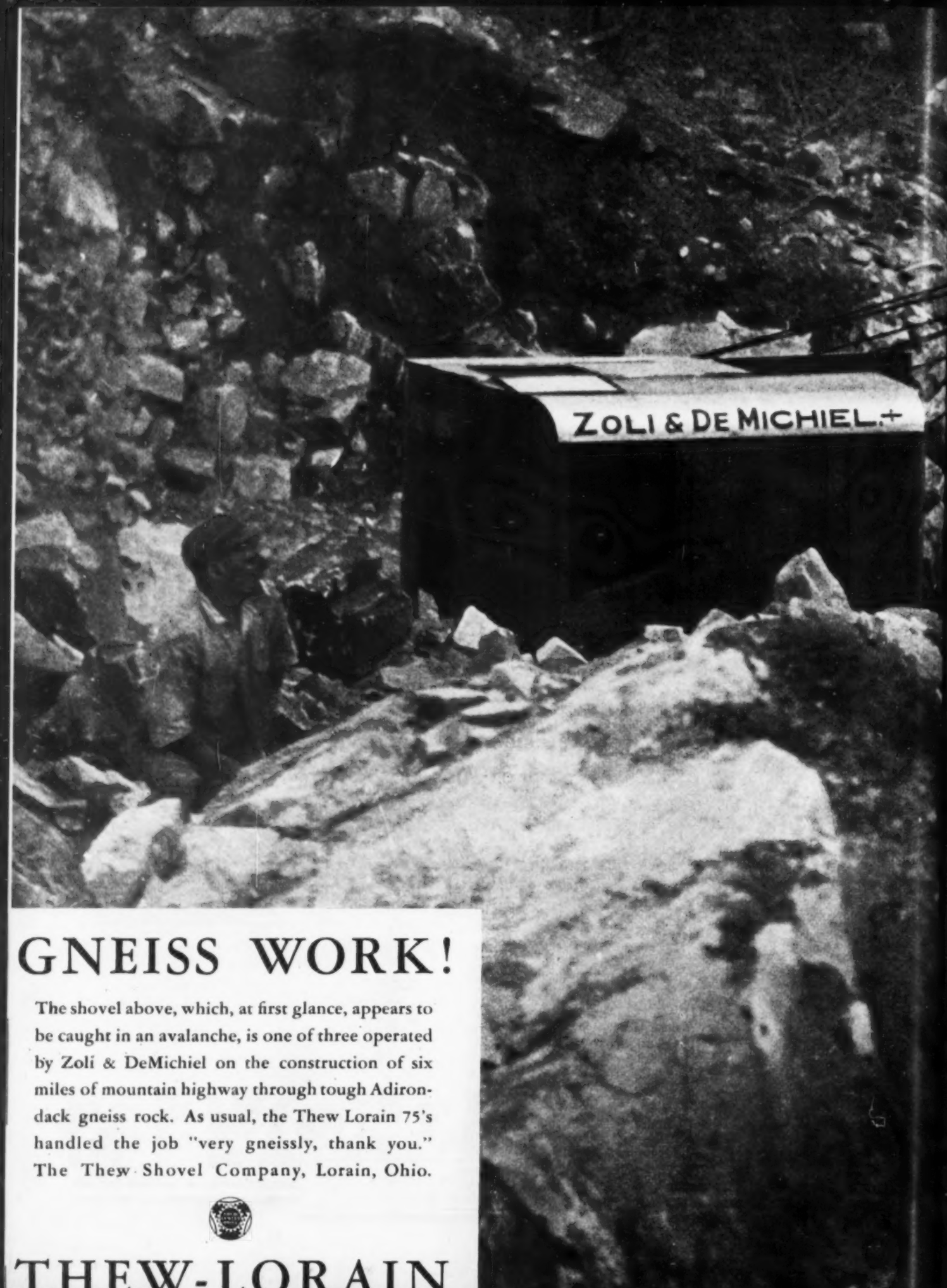
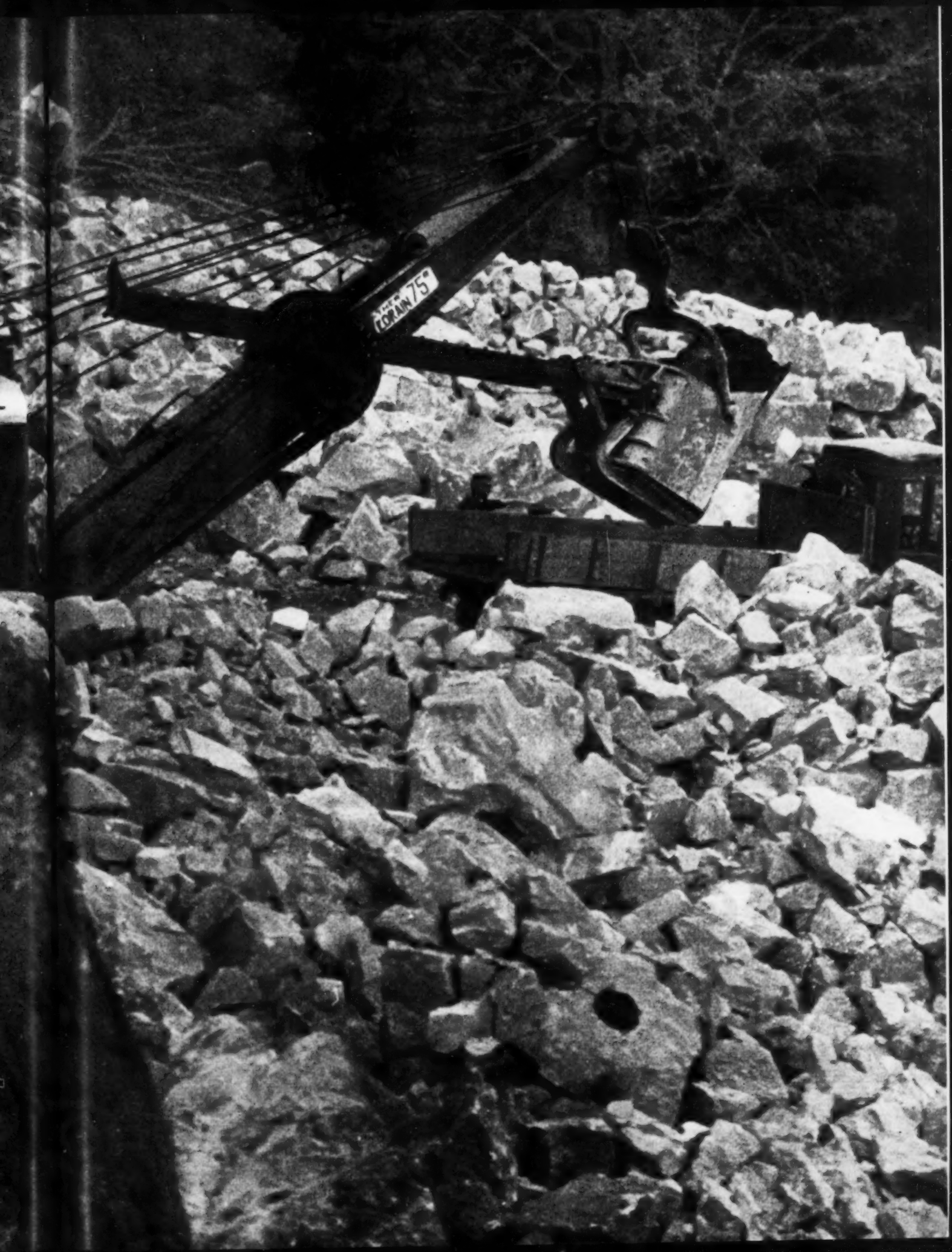
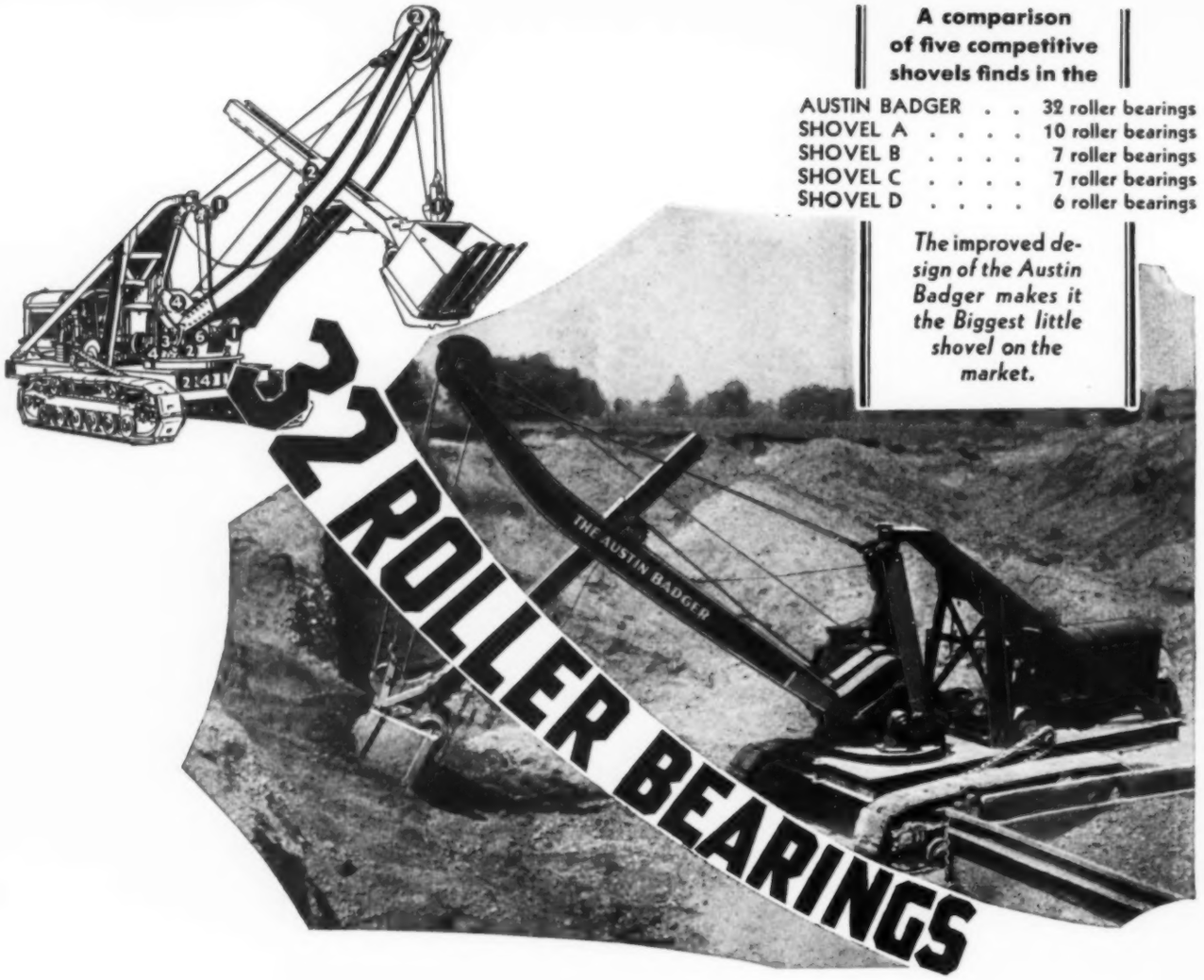


GNEISS WORK!

The shovel above, which, at first glance, appears to be caught in an avalanche, is one of three operated by Zoli & DeMichiel on the construction of six miles of mountain highway through tough Adirondack gneiss rock. As usual, the Thew Lorain 75's handled the job "very gneissly, thank you." The Thew Shovel Company, Lorain, Ohio.

THEW-LORAIN


FORAIN 75



A comparison of five competitive shovels finds in the

AUSTIN BADGER . .	32 roller bearings
SHOVEL A	10 roller bearings
SHOVEL B	7 roller bearings
SHOVEL C	7 roller bearings
SHOVEL D	6 roller bearings

The improved design of the Austin Badger makes it the Biggest little shovel on the market.

THIRTY-TWO roller bearings are used in the Austin Badger, one on every moving part forward of the power plant. The exclusive Austin design (three to five times more roller bearings) provides for greater application of available power, smoother, faster operation, minimized maintenance and longer life.

The added advantages of the Austin Badger are many—more dumping height, more dipper capacity, roller chain crowd, greater portability and low cost operation. These advantages mean more yards per day—time and money saved in repairs and maintenance—and loading, unloading and transporting of the shovel from job to job.

In the Austin Badger you get a plus 3/8 yard (11 cu. ft.) shovel, amply powered, fully convertible for crane, drag line or back filler, an all-purpose utility tool for speedy, economical operation.

Send for complete details and a copy of Bulletin No. 1236.

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Construction Methods

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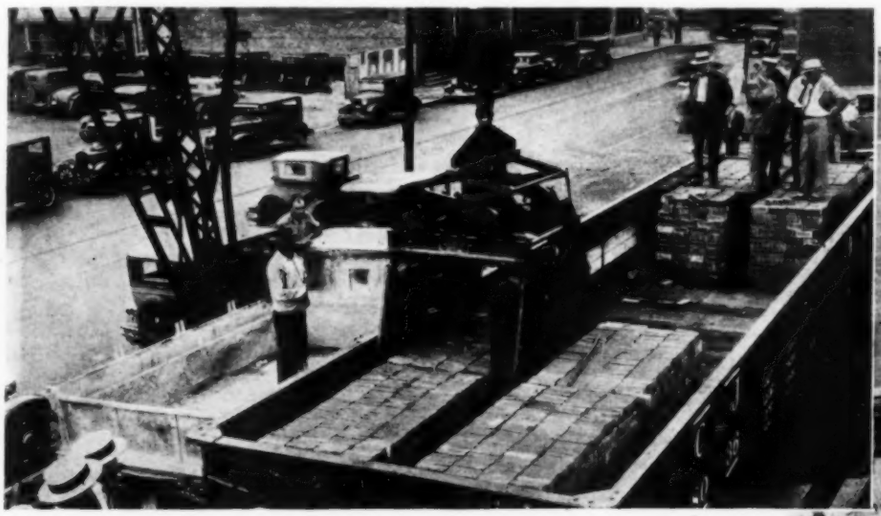

BRICK GRAB

Handles Units Intact Without Aid of Pallets or Containers

BRICK GRAB *(left, above)* slips over unit of 1,500 brick in gondola car after wood barriers on two sides of brick stack have been removed. CRANE *(above)* transfers stack to truck, grab supporting 1,500 brick by pressure on bottom course of unit.

A MECHANICAL grab built on the pincers principle is being used by several brick manufacturers and dealers in the vicinity of New York to handle 1,500-brick units without assistance of any auxiliary supporting device. The grab is a self-contained mechanism with a single-point pick-up which can be operated by any crane with sufficient hoisting capacity. A stack of 1,500 brick, 32 in. wide by 64 in. long by 48 in. high, is picked up and supported by the pressure of the two jaws of the grab upon the bottom course of brick. This pressure, which automatically increases with the load, is exerted upon the bottom course of the unit through a number of spring-steel buttons which bear against the brick. Steel-plate sides on the grab hold the brick unit intact during handling.

Use of the grab is of advantage to the dealer and building contractor because it assures a definite brick count and no breakage. It is reported that manufacturers at first found the extra labor cost of stacking the brick in units to be 8 or 9c. per thousand. This cost soon was reduced to 4 or 5c. and was absorbed by the manufacturers. When shipping by barge, the manufacturer saves something in rental through faster unloading and earlier release of barges at the dealer's dock. For rail shipment, in gondola cars, the brick units are separated by wood or steel barriers which are removed to permit the grab to slide down the two sides of each stack.

With the present size of grab, manufactured by the Paul Gabriel Corp., of Newark, N. J., it is possible to handle brick from the manufacturing plant through the dealer's yard to the job. A 6,000-lb. brick unit, however, is too large for handling inside a building. By the use of smaller grabs of similar design it would be possible to break down the large brick stack into halves and quarters and to handle 3,000-lb. and 1,500-lb. units on the job.

This Month's "News Reel"

WELDING SPEED RECORDS are claimed on the 26-in. natural gas pipe line from Kettleman Hills to Los Angeles, Calif. Using Lincoln shielded arc process, firing line welds on 40-ft. pipe sections were made at rate of 22 per crew per 9-hr. day, with actual welding time 17 min. per joint, including cleaning and brushing two beads of weld metal. A 124-mi. section was welded by eight firing line crews, under H. C. Price, Inc., of Bartlesville, Okla., in 112 9-hr. days.

Photo, Lincoln Electric Co.

CONCRETE ARCH SPAN *(below)* and steel centering for Ridge Road Bridge built at Rochester, N. Y., by Booth & Flinn Co. of Pittsburgh. Main arch, with 150-ft. clear span, consists of four ribs, poured in pairs and faced with granite. Centering was shifted sideways after first two ribs had been poured. Stiff-leg derricks with 200-ft. booms erected centering as semi-cantilever with tie-backs. In charge of construction, George Hockensmith, vice-president and general superintendent, and H. N. Crichton, superintendent.

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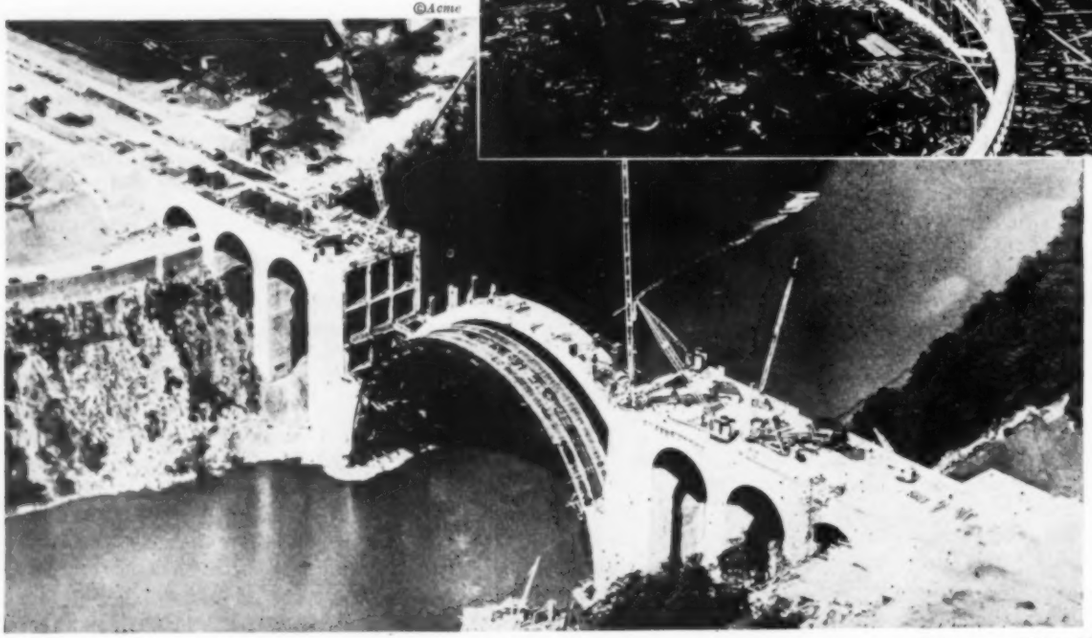


CHICAGO'S EXPOSITION BUILDINGS *(above)* for 1933 world's fair take form. This view shows present status of construction for semi-circular structure to house products of electrical industry for Century of Progress display. Across lagoon in middle background is Hall of Science.

©Press Cliché

DNIEPER RIVER DAM under construction at Kichkas, Russia, is nearing completion for Soviet 750,000-hp. (ultimate) hydro-electric project to cost $110,000,000. Construction quantities include: 1,500,000 cu.yd. of concrete; 2,300,000 cu.yd. of rock excavation; 4,400,000 cu.yd. of earth excavation; 300,000 tons of portland cement.

©Acme

RADIO CITY begins to take form in midtown New York as steel erection *(above)* starts on one of the group of buildings. Huge co-ordinated building project, under Rockefeller financing, occupies three city blocks between Fifth and Sixth Aves., and 48th and 51st Sts. A 60-story steel frame office building illustrated in architect's sketch *(at right)* forms central unit of group of five skyscrapers. Builders are Todd, Robertson, Todd Engineering Corp., and Todd & Brown, Inc. Among contractors on project are Clarence L. Smith, Inc. (excavation), Post & McCord (steel erection), John Lowry, Inc. (general contractor), George J. Atwell Co. (excavation); Hegeman-Harris Co. (general contractor), Gahagan-Canavan Corp. (excavation), Barr, Irons & Lane, Inc. (general contractor).

Photo—W. A. Davis

PRELIMINARY CONSTRUCTION OPERATIONS progress rapidly in Black Canyon of Colorado River. Downstream portals for three of four 50-ft. diversion tunnels can be seen. Site of dam is just beyond rocky point jutting into river from Arizona (right) side.

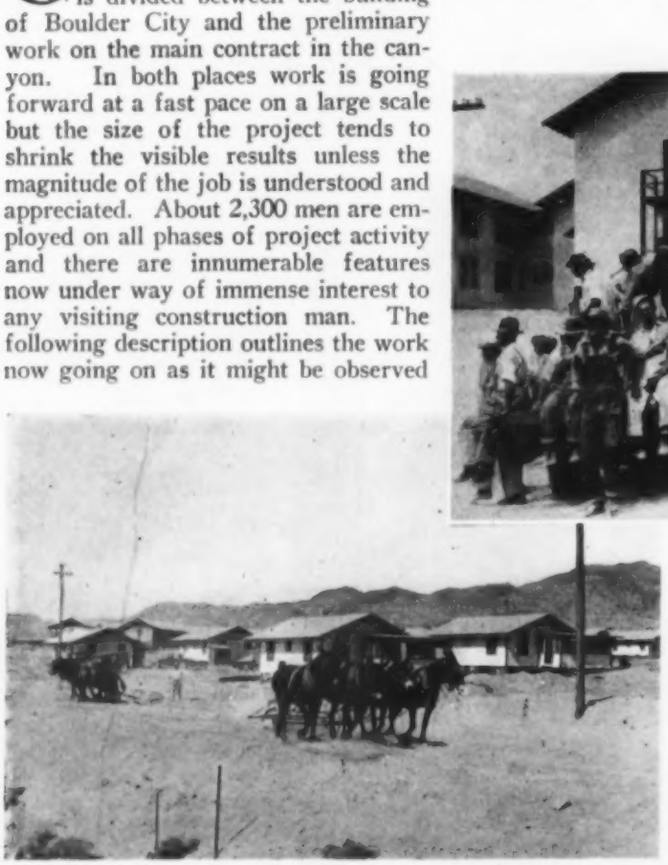
Construction Activities Cover Wide Range at HOOVER DAM

By J. I. BALLARD

Assistant Editor, Construction Methods

CONSTRUCTION interest on the Hoover dam project today is divided between the building of Boulder City and the preliminary work on the main contract in the canyon. In both places work is going forward at a fast pace on a large scale but the size of the project tends to shrink the visible results unless the magnitude of the job is understood and appreciated. About 2,300 men are employed on all phases of project activity and there are innumerable features now under way of immense interest to any visiting construction man. The following description outlines the work now going on as it might be observed by a construction man in a trip over the project.

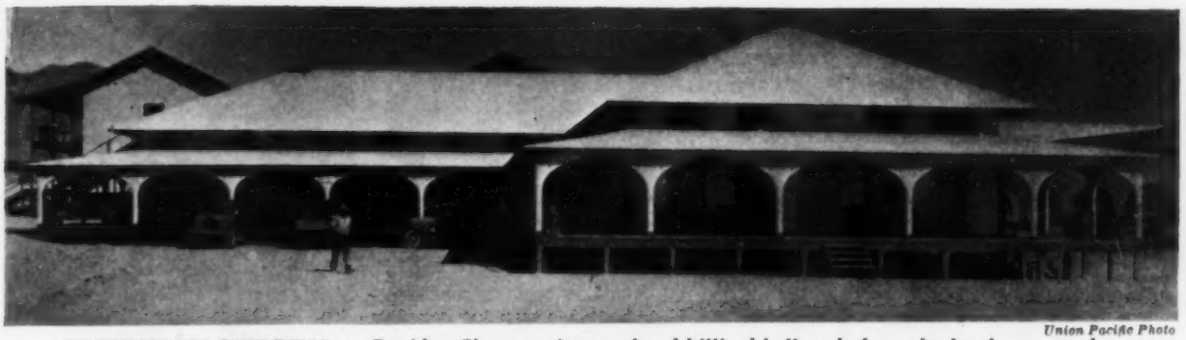
Las Vegas—The gateway to Boulder dam activity is this railroad town with an accredited population of 8,000 and a floating surplus of nobody knows how many more. An evening in Las Vegas finds the town's main street thronged with workers from the project and loafers principally interested in the pursuit of Lady Luck in the gambling places run wide open, according to Nevada law. In the spring or fall the weather is ideal; winter weather is clear and chilly, but the summer heat is almost unbearable.



FOUR-UP MULE TEAMS pull scraper equipment used on street-grading work in Boulder City.

MESS CALL! Hungry workers arrive for meal. In background is 172-man dormitory.

SHOVEL HANDLES DESERT SAND in grading street at Boulder City. Fine sand flows like water.



Union Pacific Photo

RECREATION BUILDING at Boulder City contains pool and billiard hall, soda fountain, lunch counter, bar, barber shop, tobacco store and reading rooms.

Desert weather requires no description for the experienced, and cannot be adequately described to others. Hotel rooms with the temperature far above 100 deg. after midnight indicate what may be expected.

Las Vegas is growing rapidly with buildings being added to the town's main street, a gas supply recently completed and other typical improvements under way. It is a division point on the Union Pacific between Salt Lake City and Los Angeles. The influx of unemployed has subsided to some extent and the situation is not so extreme as it was several months ago. However, there remain plenty of cases of idle men and destitute families. Many of these have encamped on the outskirts of town and live under indescribable conditions.

Boulder City—A ride across 25 mi. of desert over oiled and graveled road and through the control station of the U. S. marshal, where passes are required of all entering the reservation enclosing Boulder City and the project, is an enjoyable trip. Approaching Boulder City the principal feature of the new town is the group of large frame structures which constitute the main buildings and shops of Six Companies, Inc., near the end of the railroad terminal. Beyond these stretch row on row of the contractor's small frame houses flung far out across the desert. The north side of the town site rises rather sharply to a dividing line of hills and this ridge is occupied by the 2,000,000-gal. steel water storage tank for the town supply and the government buildings. At present the streets of this embryo town can be distinguished only by the water and sewer line trenches cut across the raw desert, although some street grading is under way. Street construction will be rushed as trench work is completed.

OILED HIGHWAY extends from Boulder City about 8 mi. to rim of canyon.

Within the next few months the town will be able to boast of paved streets in the business section and oiled macadam roads throughout the residential area.

The principal group of Six Companies' buildings is seen to consist of seven 172-man dormitories, the mess hall with separate dormitory, administration building, recreation hall, and laundry. In addition, the Boulder City Co., a completely owned subsidiary of the Six Companies, organized to carry on the town activities of the company, has an office building and is opening a large department store as one of its principal activities.

Other building activity of the Six Companies at Boulder City has resulted in the completion of about 140 three-room and 175 two-room houses to be rented to their employees, and a group of 25 six-room houses to be occupied by their administration forces. These facilities, according to contract, must provide for at least 80 per cent of their construction force. The rest of the crews may be maintained in camps on other parts of the project. At present these additional camp facilities are concentrated in a 500-man camp in the river canyon upstream from the site. The population of this camp fluctuates rapidly, depending on the work in the canyon and the progress on housing facilities in Boulder City.

Housing and Feeding—Provision for the health and comfort of employees at Hoover dam exceeds that attempted for any other similar construction project. It has been estimated that $140 per man has been spent by the Six Companies for housing and feeding facilities. The main dormitories provide individual rooms for which the men are charged 10c. per day. Because of the severity of the climate, provision has been made to supply all these main buildings with a forced

TWO- AND THREE-ROOM HOUSES, for married employees of Six Companies, Inc., are of timber-frame construction with asbestos-shingle roofs. Ventilating space is provided between ceiling and roof.

LADDER-TYPE EXCAVATOR digs sewer trenches in raw desert land on future street lines of Boulder City.

SEWERS are vitrified clay pipe from 6 to 12 in. in diameter with poured asphalt joints.

draft of water-washed air which is cooled in the summer and heated in the winter. This conditioned air is piped from four central plants to the buildings and distributed through sheet metal air ducts.

The contract for boarding all Six Companies forces was let to the Anderson Bros. Supply Co., Los Angeles, and is in direct personal charge of Harold S. Anderson, who was in charge of mess-halls in all government shipyards during the War. Arrangements are particularly elaborate, centering around a 1,000-man mess hall, and include a kitchen equipped for steam, oil or electric cooking, with cooking utensils of aluminum and the latest type of mechanical aids to provide meals of the best quality of food. The two 500-man dining rooms are equipped with electric fans and individual chairs at the tables. Food materials are brought in either by truck or rail and can be stored in carload lots in the cold storage room refrigerated by a 20-ton Parker ice plant. Dairy products are produced at a ranch purchased by the Anderson Bros. for this particular job and brought to Boulder City in ice-cooled trucks. Lunches for those in the field are a matter of choice and each man is allowed to fill his lunch box from a large display with as much food as desired. Six Companies' employees are charged $1.50 a day for board. A hospital fee of $1.50 per month per man is charged.

Six Companies' Family Houses—The three hundred-odd houses being erected by the Six Companies' force are of timber frame construction with asbestos shingle roofs. The outside of the studding is covered with "Grip" lath which is later stuccoed; the inside of the walls is covered with wallboard. Ventilating space is provided between ceiling and roof. The houses are equipped with gas ranges and, under contract with the Standard Oil Co. of California, facilities are provided for supplying "canned" gas which will be purchased by the occupant of the house. Electricity will be supplied wholesale to the Six Companies and redistributed. Water is to be purchased individually from the city government. The houses will be rented by the month to employees of the Six Companies at a charge estimated to amortize the cost during the construction period.

Government Buildings — Buildings erected by the Bureau of Reclamation, include the Administration Building, Dormitory, City Municipal Building, and the 24 three- and four-room houses built for officials. These all have hollow brick walls, double floors and a layer of 4-in. rock wool on the ceiling. The walls are laid up of Rolok construction which is a Flemish bond, hollow wall type, providing an insulating air space. These brick walls are covered with stucco plaster, and the entire building is given a distinctly Spanish architectural treatment including tile roof. Government houses are equipped with electric stoves, water heaters, and refrigeration. Heating arrangement is provided in a fireplace of circulating air design. The main buildings will be furnace-heated, and provision is made for individual room cooling. The main buildings are built with reinforced concrete footings and floors.

Water Supply System—The water supply for Boulder City is pumped from the Colorado River, a distance of approximately 8 mi. against a 2,000-ft. head. At present, a 12- and a 10-in. line, with welded longitudinal joints and Dresser couplings, is completed from the river to the town and the pumping plants are in operation. The supply is being put through the preliminary clarifier at the river provided with Dorr equipment to remove the de-

FOUR- AND FIVE-ROOM HOUSES for government officials are of brick hollow-wall construction covered with stucco.

BRICK WALL of government house is laid with Rolok type joint to provide air space for insulation.

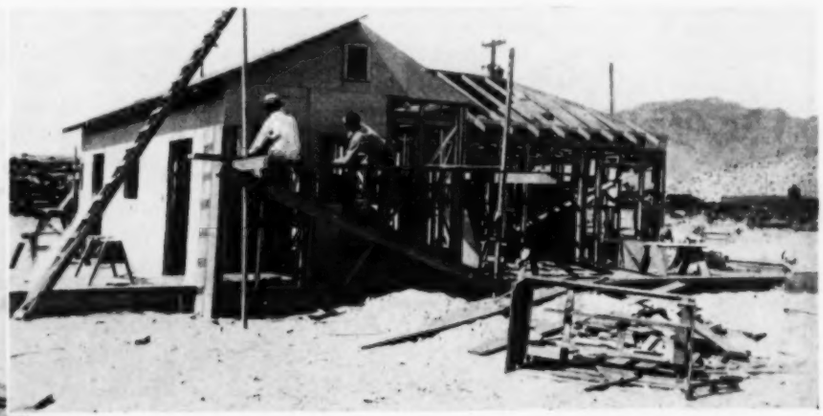
posited silt and is chlorinated. Construction of the permanent filtration plant at Boulder City is under way. When this is completed, the system will be operated by delivery of the pumped supply into a 100,000-gal. receiving tank from where it will flow by gravity through the filtration plant. It will then be pumped into the 2,000,000-gal. storage tank overlooking the town site and will flow into the city distribution system.

centrifugal pumps, each operated by a 200-hp. motor against a 1,000-ft. head through 4 mi. of 12-in. line to the second pumping station. At this station a duplicate set of pumps raises it the rest of the way to Boulder City. This second pumping plant is equipped for automatic operation, depending on the head built up in the 95-ft. surge cylinder which is connected to the line just below the pump.

Municipal Improvements—The New Mexico Construction Co., Albuquerque, N. M., is installing the water mains, sewers and street improvements.

street grade are 3 and 5 ft., respectively, but trench depths frequently exceed these figures because the street excavation is a subsequent operation.

The 11 mi. in the sewer system, ranging from 6 to 12 in., is of vitrified clay pipe, laid with a hot poured asphaltic joint. This system, which has already been connected to the principal buildings, leads to a 12-in. vitrified outfall line that discharges into a temporary timber-lined septic tank about



TYPICAL FAMILY HOUSE as constructed by Six Companies, Inc. Outside of studding is covered with "Grip" lath which is later stuccoed; inside wall is covered with wall board.

ATTACHING PLASTERBOARD *(left)*, later to be covered with stucco, to outside of typical house. Ventilator affords some draft through air space under roof.

TIMBER FRAMES for Six Companies' houses rise by dozen in residential area of Boulder City.

STUCCO FINISH *(right)* is applied to surface of plasterboard on wall of Six Companies' house.

The river intake is provided with an adjustable pumping station that can be regulated to suit the stage of the river and the layer of clearest water. Three motor-operated pumps lift the water approximately 100 ft. into the desilting tank where it loses approximately 95 per cent of the suspended matter. The settled water is then pumped by three 650-g.p.m. four-stage Byron Jackson

Trenches are dug with standard bucket excavating equipment through the sandy desert soil which contains some streaks of hardpan. Depths to water and sewer lines from finished

$\frac{1}{4}$ mi. from town. The effluent flows through a rocky gorge and into the dry desert sand. The permanent disposal plant now under construction will be of the separate sludge digestion type, and the effluent will be discharged in the present manner.

(To be concluded).

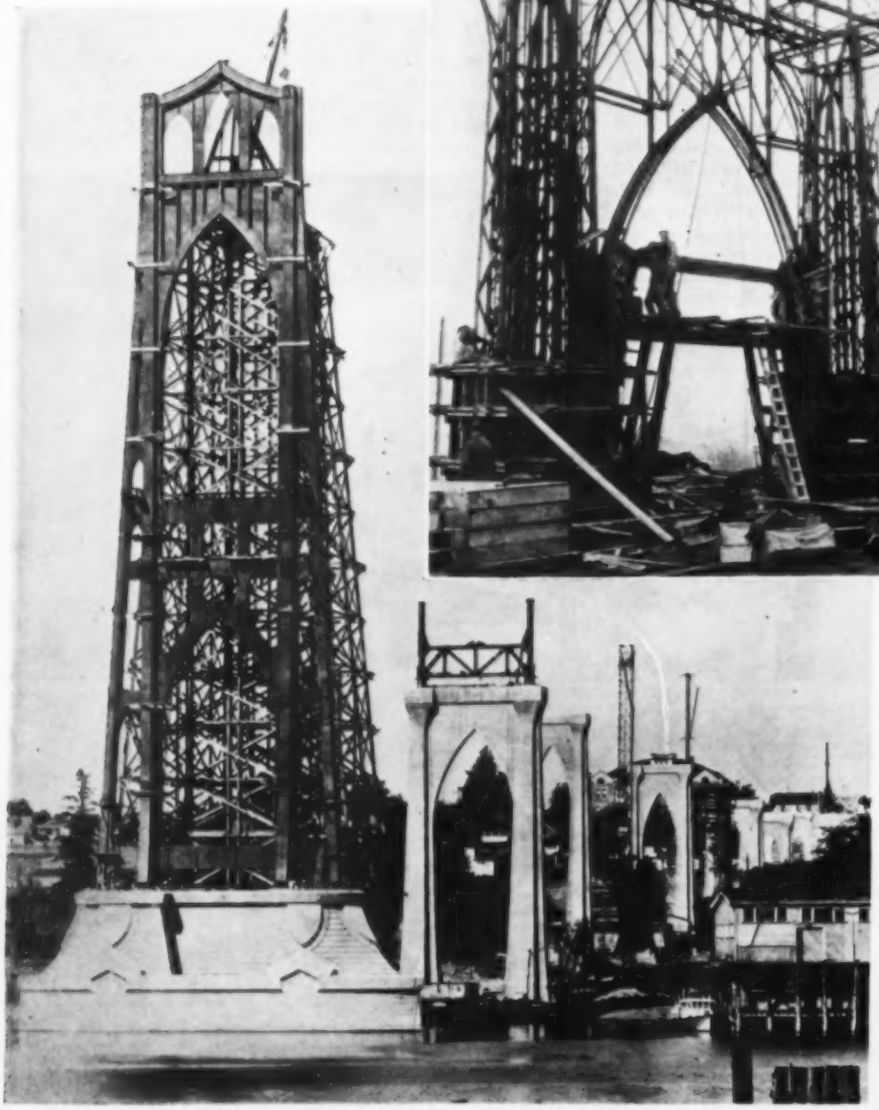
ROPE-STRAND CABLES

Support 1,207-Ft. Suspension Span

A NEW method of stringing wire-rope cables for the St. Johns bridge across the Willamette River at Portland, Ore., was the most important construction feature of a project which involved, as well, interesting operations in building reinforced-concrete viaduct piers and in erecting structural steel towers and trusses. The St. Johns bridge is the largest rope-strand suspension structure yet built, with a main span of 1,207 ft. and side spans of 430 ft. 3 in. each. Pleasing architectural effect was gained by use of the pointed Gothic-arch motif in viaduct piers and steel towers.

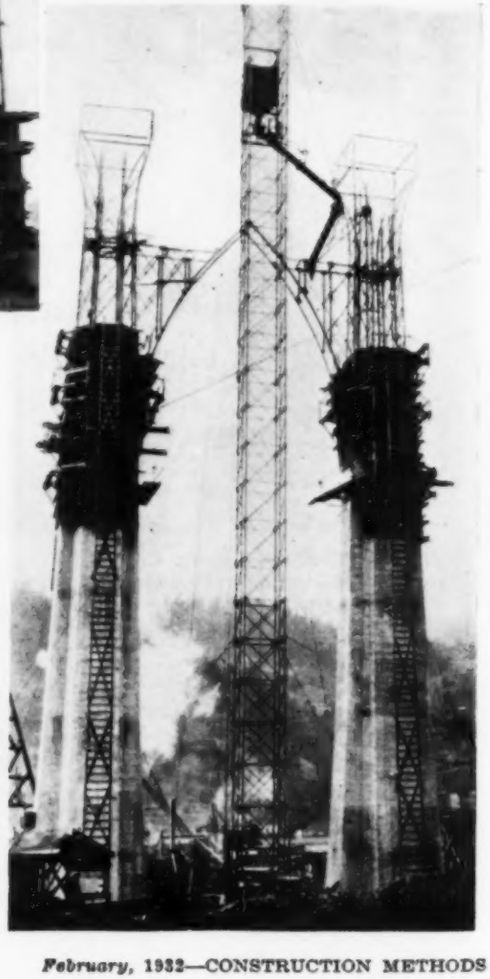
Clearances required by navigation were 205 ft. at the center of the main span and 203.6 ft. for a channel width of 440 ft. The bridge roadway is 40 ft. wide, with a 5-ft. sidewalk on either side. To permit deflection of the back stays, steel cable bents were erected on the piers at the ends of the side spans. The east anchorage is a concrete gravity structure carrying one of the viaduct piers and resting on 516 MacArthur concrete pedestal piles. On the west side, the cables are anchored to structural steel embedded in wedge-shaped tunnels filled with concrete.

Cable Erection — The two main cables, each 16¾ in. in diameter, are 52 ft. apart and have a length of about 2,720 ft. between anchorage fastenings. Each cable consists of 91 prestressed 1½-in. galvanized wire bridge strands, each, in turn, made up of 51

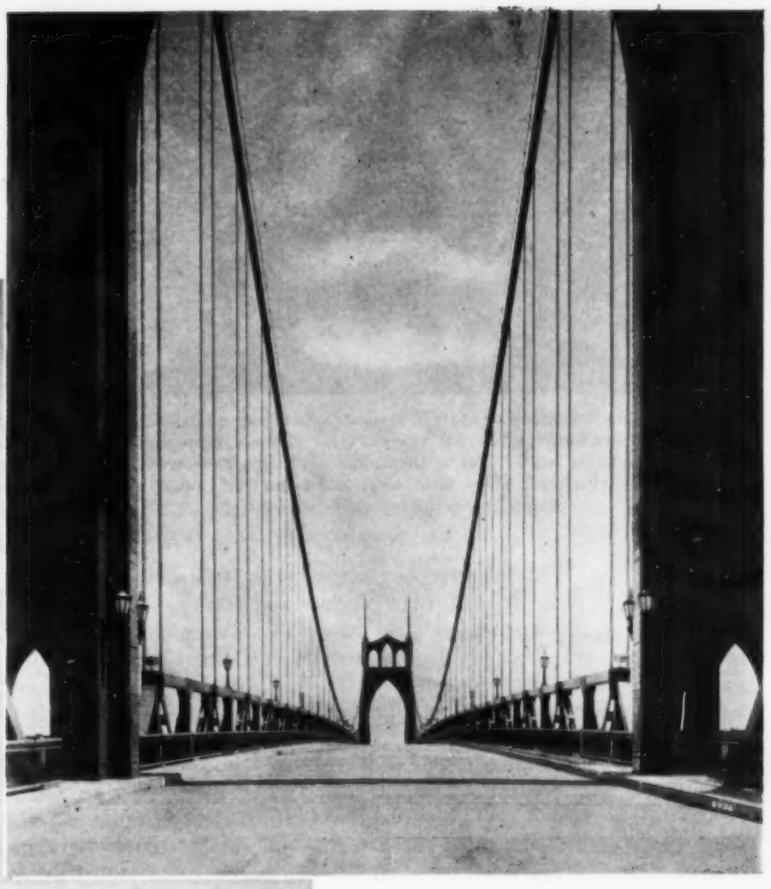


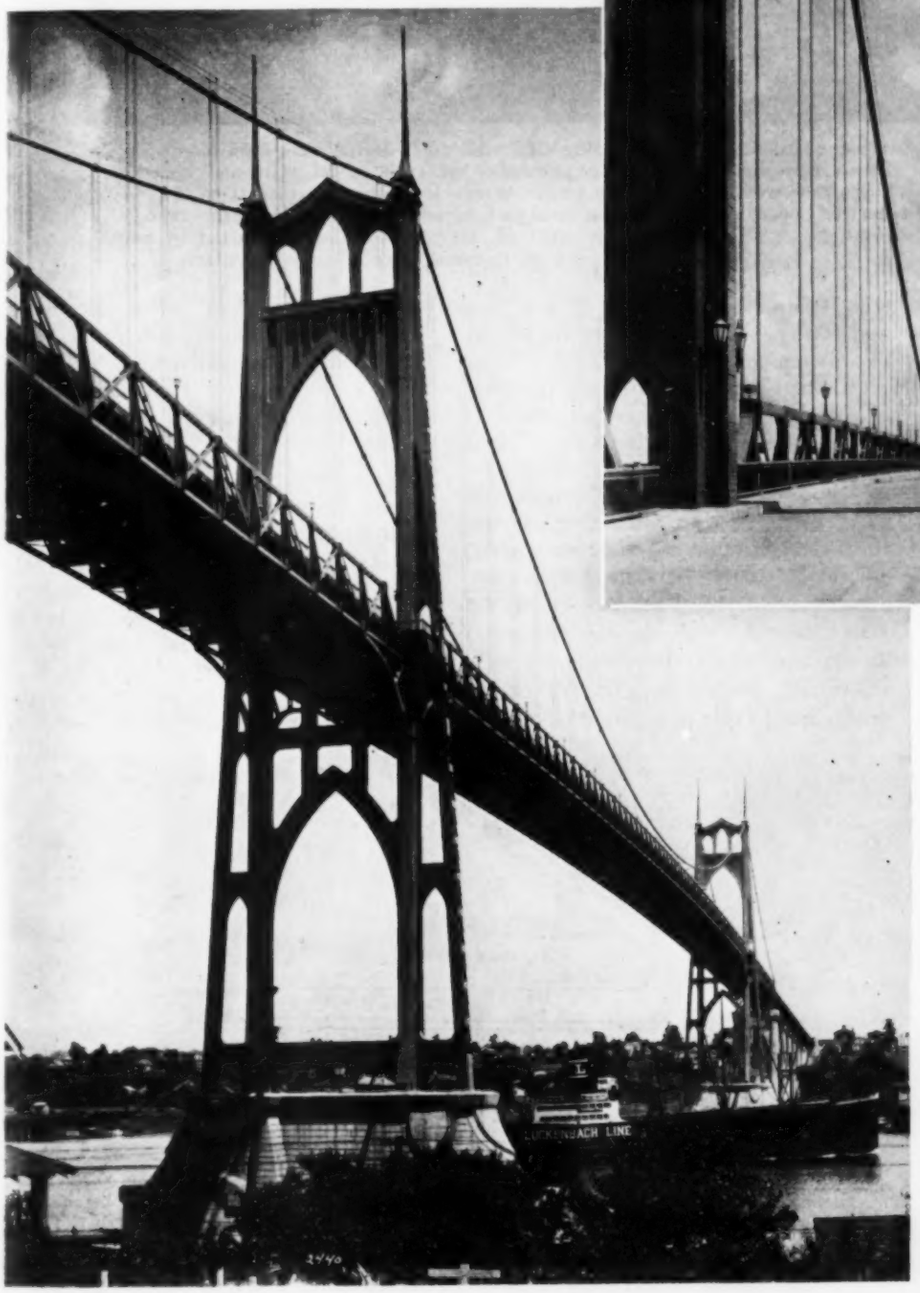
TIMBER FALSEWORK TOWER rising to El. 300 on land side of main pier enables stiff-leg derrick with 80-ft. boom on top to erect all steel in main tower. **STRUCTURAL-STEEL FRAME** *(above)*, 4 in. from face of concrete, supports panel forms on viaduct pier.

TUBULAR TOWER *(below)* **to maximum height of 210 ft. elevates concrete for delivery to viaduct piers up to 150 ft. tall. Mast hoist up to 180 ft. high is used on some piers.**



40-FT. ROADWAY *(right)* and two 5-ft. sidewalks provide for traffic across bridge. Light standards at 80-ft. intervals are erected on stiffening trusses. 1,207-FT. MAIN SPAN *(below)* provides 205-ft. clearance at center. Pointer arch design is used twice in each main tower, one arch below roadway and one above. Tower legs are cellular and are divided into nine vertical sections milled to bear against one another. Spires 50 ft. high on towers support flashing aviation beacons.





wires varying in diameter from 0.100 to 0.196 in. and aggregating a cross-sectional metallic area of 1.337 sq.in.

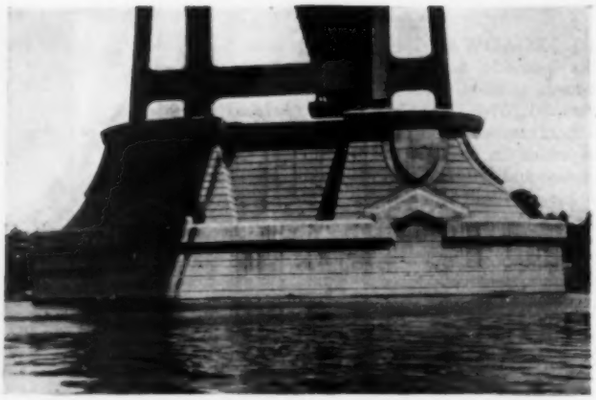
Instead of the usual footbridges employed in erecting parallel-wire cables, the John A. Roebling's Sons Co., contractor, evolved a scheme for stringing the strands by rope tramways alone. Two 1-in. track ropes 10 ft. apart were erected over each cable. These ropes supported steel cages at the center and quarter points of the main span and at the centers of the side spans. The cages served as platforms for workmen who participated in erection and adjustment of the strands.

Two independently-operated hauling ropes passed through the erection cages and across the main towers, from anchorage to anchorage. The upper hauling rope was a 1-in. rope and the lower was a $\frac{3}{4}$-in. Each formed a continuous loop serving both cables and passed through tightening frames at the east anchorage to take up the stretch in the rope developed by use. The steel cages were attached to the upper 1-in. rope when it was desired to change their position along the track ropes. Actual pulling of the strands across the river was performed by the $\frac{3}{4}$-in. rope.

To string a strand, the reel containing the strand (total weight about $6\frac{1}{2}$ tons) was set in a reel stand on the east anchorage and the socketed end of the strand was attached to the hauling rope by a special connection. Some difficulty was occasioned at first by the twisting of the wire-rope strand about the hauling rope. This cause of delay was eliminated by the adoption of a swivel connection, adapted from logging practice, which allowed the strand to twist independently of the hauling rope. The unrestrained twisting resulted in a slight change in strand length, which was corrected by shim adjustment at the anchorage connection. To control the sag of the strand as it was pulled across the river, steel U-shaped guides were hung from the upper hauling rope at intervals of 120 ft., and the bridge strands were pulled through these guides.

The 91 cable strands, as erected, formed a regular hexagon. Cable bands, shaped to fit the scalloped outline of the hexagon, were fastened to the cable at intervals measured in the

EAST ANCHORAGE is massive gravity-type structure containing 12,500 yd. of concrete. Heavily reinforced concrete walls divide anchorage into chambers, some of which are filled with sand and others left open to permit inspection of cable connections.

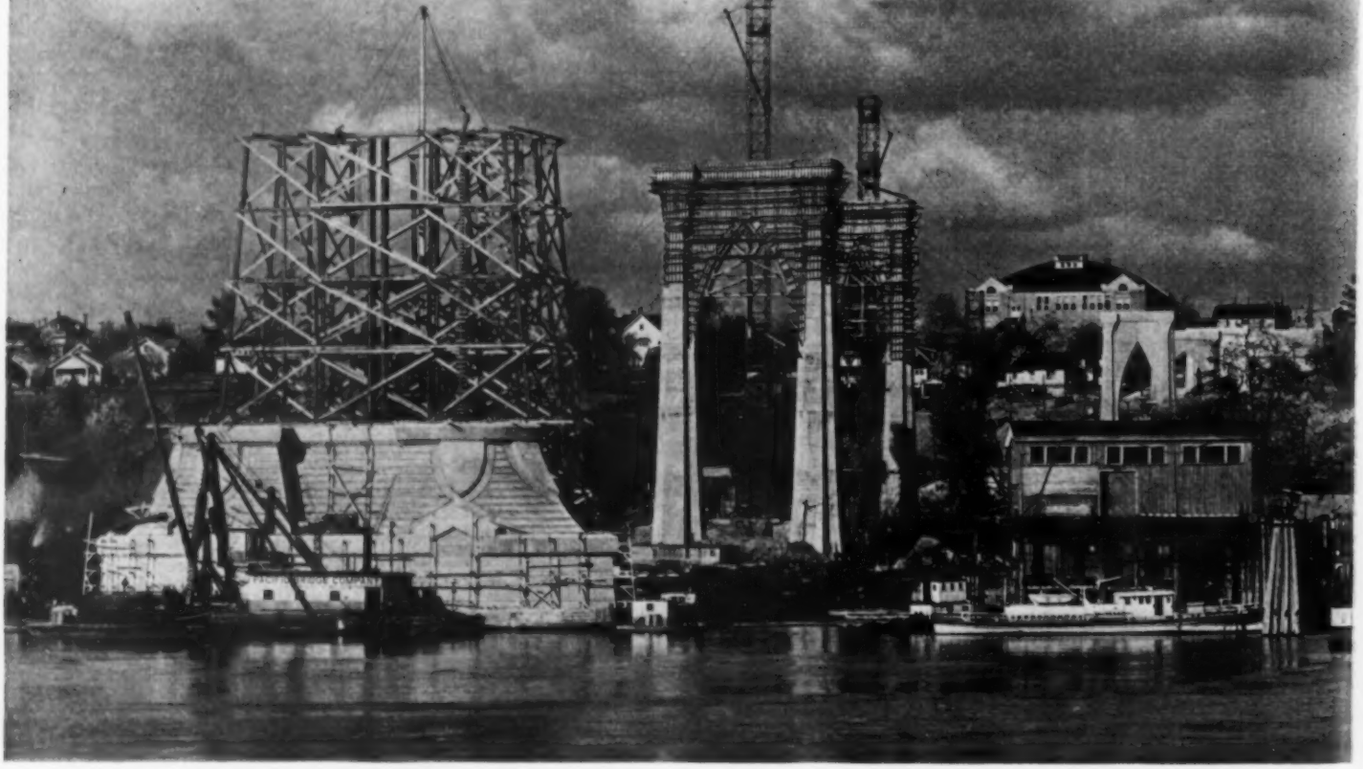


RIVER PIER rises 60 ft. above mean low water. East main pier rests on 1,068 wood piles and contains 16,900 yd. of concrete; base of pier is at El. 50. West main pier, keyed into solid rock at El. —21, contains 9,127 yd. of concrete. Concrete mixed by two 1-yd. Ransome mixers in floating plant.

field and two 1⅝-in. prestressed suspender ropes were looped over each band. After the suspended steel had been erected, the hexagonal cross-section of the cables was rounded out to circular by covering the flat surfaces with segmental strips of treated cedar about 6 ft. long, and the cables were wrapped with a continuous serving of No. 9 soft annealed double-galvanized steel wire, applied by a motor-driven machine on each cable.

Viaduct Approaches — The approaches to the bridge, 1,511 ft. long on the east side and 255 ft. on the west, consist of a series of steel deck-truss spans having lengths of 108, 144 and 180 ft. These spans are supported on tall slender piers from 22 to 150 ft. high, each consisting of two tapering shafts rising from a heavily reinforced footing to form a Gothic arch. Rigid structural-steel frames, forming part of the shaft reinforcing, supported panel forms used in concreting. Structural-steel erection and concreting went forward by 20-ft. lifts, the Gilpin Construction Co. of Portland, using an Erie crane for the shorter piers and an Archer tubular tower carried to a maximum height of 210 ft., or an Insley mast-hoist to a height of 180 ft. for the taller piers. For the west anchorage and west approach piers, the La Pointe Construction Co., of Portland, employed an electrically-operated stiff-leg derrick and a wood concreting tower.

Main Piers and Towers — The Pacific Bridge Co. of Portland, under subcontract with the Gilpin Construction Co., constructed the main river piers, which rise 60 ft. above mean low water. The east pier rests on 1,068 wood piles driven into hard sand by an air-operated McKiernan-Terry 11-B-2 hammer, set in 90-ft. telescopic leads to permit the hammer to follow the



EAST APPROACH VIADUCT PIERS under construction and east main pier completed. Falsework tower for steel erection under construction. Note Chicago booms on concrete towers for handling panel forms and additional reinforcing steel.

EAST APPROACH ROADWAY, 1,511 ft. long, crosses nine steel deck-struss spans on 3½ per cent grade. West approach (in background), 225 ft. in length, leads into hill 120 ft. above highway. Two-branch road along hillside drops on 5 per cent grade from bridge terminal to highway.

pile under water to refusal. Excavation to 50 ft. below mean low water was completed before the piles were driven. After the piles had been cut off by a 48-in. circular saw on an 80-ft. shaft, the crib was floated into position and a 20-ft. concrete seal was placed by tremie to El. -30. The west main pier rests on rock at El. -21. Tremie concrete was used to seal the cofferdam at this pier, also. To save concrete, 43 72-in. wood stave pipes on 9-ft. centers were placed in the body of each pier.

Main tower steel was fabricated in the Seattle, Wash., shop of the Wallace Bridge & Structural Steel Co. and was erected under subcontract by the J. H. Pomeroy Co., of Portland. The towers are 284.5 ft. high from base plates to milled plates at the top on which the cable saddles rest. The subcontractor built a timber falsework tower to El. 300 on the land side of each pier and erected all the steel without moving a wood stiff-leg derrick, with an 80-ft. boom, on top of the falsework tower.

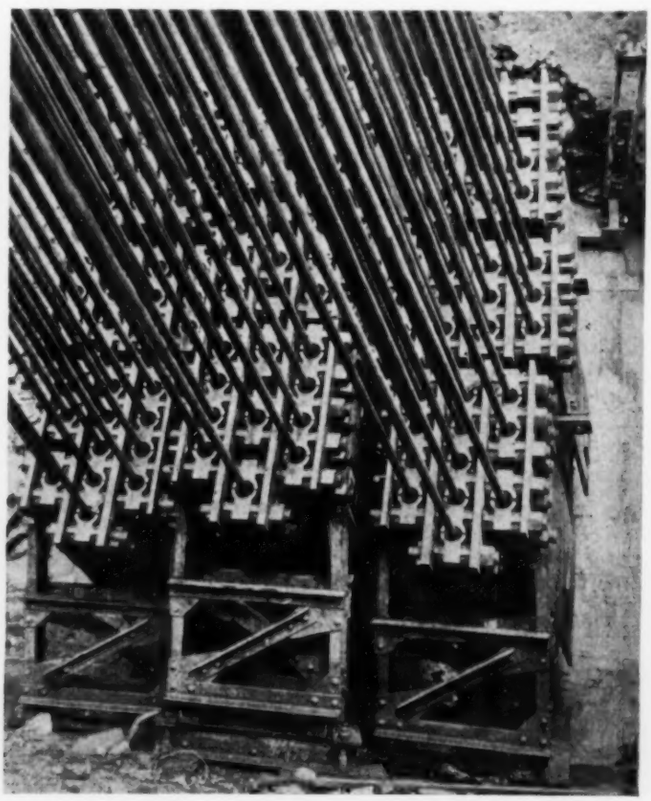
Truck-Mixed Concrete — Approximately 40,000 yd. of concrete used in viaduct piers, anchorages and roadway was mixed and delivered by Transit truck mixers of Swigert, Hart & Yett, Inc., Portland. Lindstrom & Feigenson, of Portland, poured the reinforced-concrete roadway deck and sidewalks.

Steel Erection — Suspended steel was erected by the J. H. Pomeroy Co. under subcontract with the Wallace Bridge & Structural Steel Co. The steel was brought to the site in barges and was hoisted by sets of falls suspended directly from the cables.

Viaduct steel was erected by the American Bridge Co., under sub contract with the Columbia Steel Co.

Administration — The St. Johns bridge was built by Multnomah County at a cost of nearly $4,000,000. Robinson & Steinman, New York, designed the structure and supervised construction. R. Boblow, resident engineer for Robinson & Steinman, supplied the data and photographs for this article.

SUCCESSION OF POINTED ARCHES affords pleasing architectural effect in piers supporting east approach spans, carrying out dominating design motif.



AT ANCHORAGE, rope-strand sockets bear against castings locked between vertical bars pinned to main anchorage steel. Shims inserted between socket and casting adjust strand length.

STEEL LINER PLATES backed up with straw packing support tunnel arch in quicksand. Timber bulkhead holds face while bricklayers advance three-ring brick sewer of 5-ft. inside diameter approximately 20 ft. to end of heading. Steel arch lining extends to springing line, where it is supported by 3x12-in. timber posts wedged between flanges of liner plates and slabs bearing on earth shoulder of invert.

STEEL LINER PLATES

Speed Cleveland Sewer Job

ECONOMY, safety, and efficiency were served by the adoption of steel liner plates for shaft lining and tunnel roof on the contract of the Cogito Construction Co. for 5,600 ft. of the southerly intercepting sewer in Cleveland, Ohio. The sewer, of three-ring brick circular section, with finished inside diameters of 5 ft. and 4 ft. 4 in., passes through several areas of quicksand, although in no place was the pressure sufficient to make compressed air necessary.

Remarkable speed was made in sinking four 16-ft. diameter shafts 60 ft. deep. The shafts encountered 6 ft. of quicksand at 30-ft. depth. By lining the shafts with steel plates as excavation progressed, the contractor was able to complete them at an average labor expenditure of 192 man-hours each. As the shafts are back-filled, the plates are removed.

As the tunnel heading advanced from the shaft, lining of the arch with steel plates was kept close to the face. In quicksand, one liner plate at the top of the arch was installed first and jacked into place. Additional liner plates of the arch ring then were set and bolted down to the springing line. Blocks of 3x12-in. timber were wedged under the liner-plate flange at both ends of the

THREE-RING BRICK SEWER is constructed in tunnel with steel-lined roof. Bricklayers first extend invert to face of heading and then brick up arch. Materials and spoil are transported between heading and shaft in 1-yd. buckets on flat cars running on 18-in. gage industrial track.

IN DRY SAND-CLAY of filled ground, berm is cut along tunnel wall at springing line to support 3x12-in. timber blocking. Air spades are used to excavate face of heading. Arch crown at this point is only 2 ft. under ties of multiple-track rapid transit lines.

arch ring, the blocks bearing on slabs bedded in the shoulder of the invert. Where ground conditions were good, a bench was cut in the tunnel wall at the springing line, and the timber blocks rested on this bench. In this case, of course, fewer plates were used in the arch ring.

After a mucking and lining shift had excavated the heading and erected the steel liner plates of the arch roof, a bricklayers' shift constructed the three-ring sewer. This latter crew first laid the invert to the face of the heading and then added the arch. About 20 ft. of completed sewer daily was the average performance in each heading.

As manufactured by the Truscon Steel Co. of Cleveland, steel liner plates are from $\frac{7}{64}$ to $\frac{3}{8}$ in. thick. The thicknesses most used on the Cogito job were $\frac{1}{8}$ and $\frac{3}{16}$ in., with 2-in. flanges. Standards for width are 16 in. and for length $37\frac{1}{16}$ and 36 in. The longer plate is used where the diameter of the shaft or tunnel is in whole feet, one plate being required for each 1 ft. of diameter.

16-FT. DIAMETER SHAFT *(left)* is sunk to depth of 60 ft. and lined with steel plates in 192 man-hours. Liner plates are set as excavation proceeds, eliminating need for timber bracing and leaving shaft area clear. Shop-assembled stairway, made up of flats and angles, is bolted to liner plates. In another shaft, steel stairway is fastened to vertical angle bars hung from 10-in. channels laid across top of shaft. JOSEPH COGITO (at left) is president and general manager of Cogito Construction Co.; WILLIAM INGRASSIA (on step) is vice president and general superintendent.

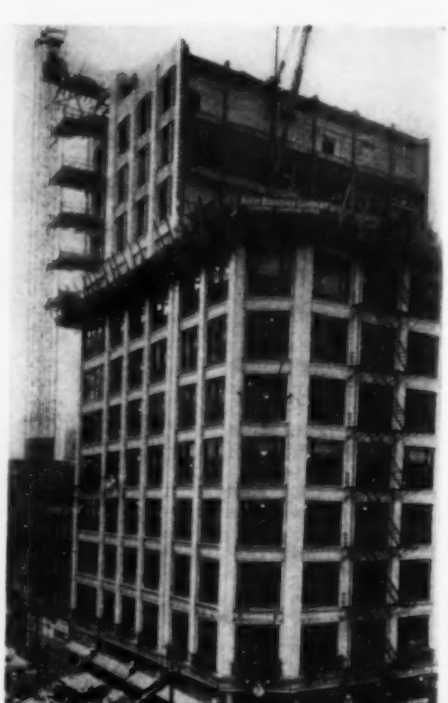
Hollow Gypsum
FLOOR-ARCH UNITS
Simplify Fireproof Construction

A NEW type of hollow gypsum tile which spans the full width between steel I-beam floor joists has lightened dead load and expedited construction of four additional stories on top of the Maurice L. Rothschild building in the Chicago Loop, for which the Avery Brundage Co., of Chicago, was general contractor. The gypsum blocks, which rest on the bottom flanges of the I-beams and which inclose the beams with a complete form for fireproofing, have sufficient beam strength to carry all construction loads without additional support. Elimination of shores and formwork simplifies the construction process and reduces labor cost. The tile are installed without use of clips, hangers or other special device.

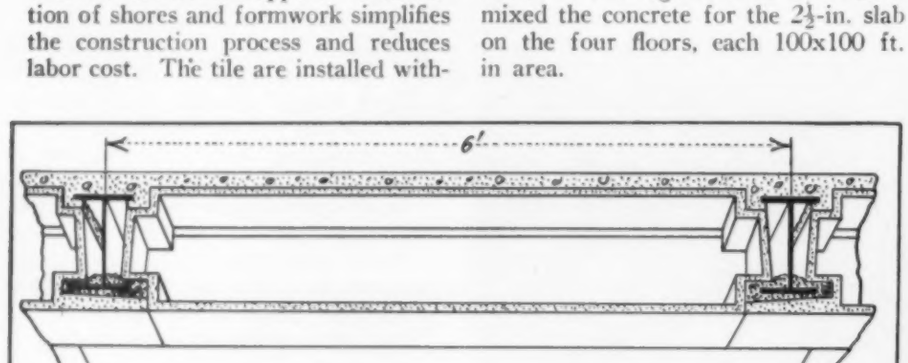
As indicated by the accompanying photograph and perspective drawing, the hollow gypsum blocks, which are both fireproof and sound resistant, are slipped over the bottom flanges of the I-beam floor joists, spaced on 6-ft. centers. The under side of the blocks form a level ceiling, and the upper surface provides a working deck as well as a form for pouring the reinforced-concrete slab. The concrete slab engages the upper flanges of the I-beams and completes the beam fireproofing.

It is reported that the hollow arch tile, manufactured at the Chicago plant of the Unitrave Engineering Co., effected a reduction in dead load of from 20 to 30 lb. per square foot. The blocks, 13½ in. deep by 12 in. wide by 5 ft. 9 in. long, were lowered into place by workmen with two straps.

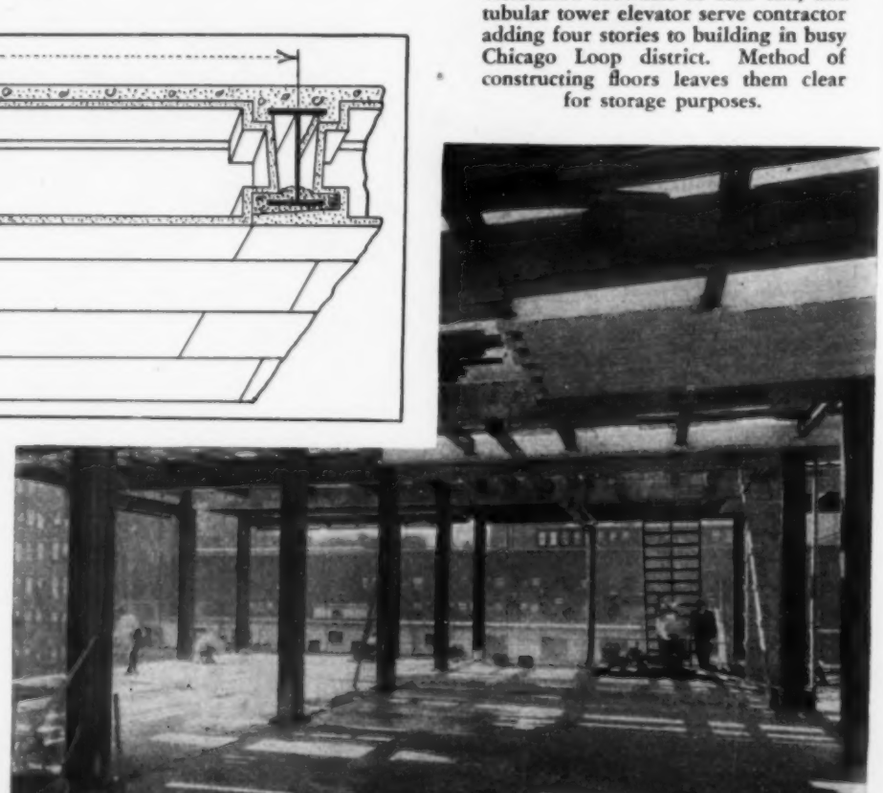
Extremely small space was available for handling materials at street level. By fencing a small area on the sidewalk and erecting a two-compartment tubular tower within this space, the contractor was able to make deliveries without impeding traffic in the busy street. Absence of shoring and forms left the floors free for storage of materials. A one-bag mixer at street level mixed the concrete for the 2½-in. slab on the four floors, each 100x100 ft. in area.



FENCED SIDEWALK SPACE, with merchant's showcase at each end, and tubular tower elevator serve contractor adding four stories to building in busy Chicago Loop district. Method of constructing floors leaves them clear for storage purposes.



HOLLOW FLOOR-ARCH UNITS carried on bottom flanges of I-beam joists eliminate need for shoring and formwork.



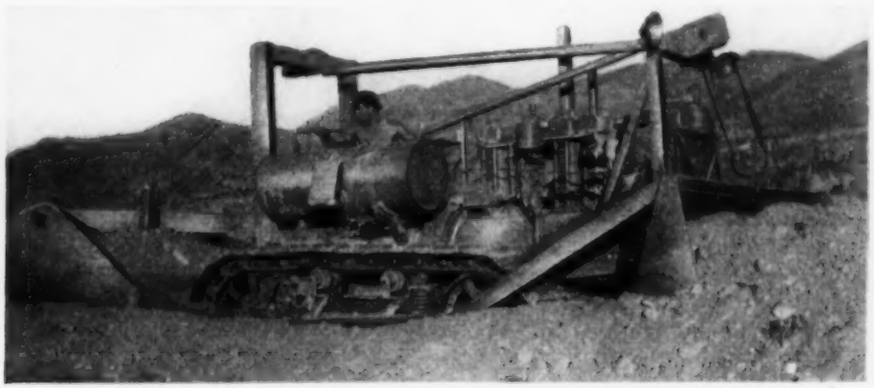
HOLLOW-TILE ARCHES form working deck for placing steel reinforcement and pouring floor slab. Erection of arch units proceeds on floor above while concrete is being poured directly underneath.

JOB ODDITIES

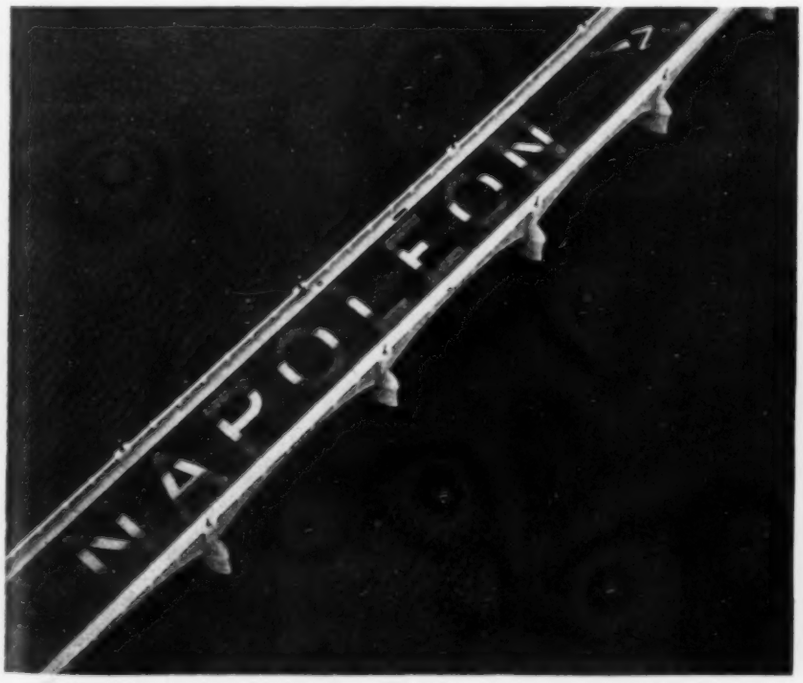
A Monthly Page of Unusual Features of Construction

BIGGEST BUCKET of open-bottom scraper type, a Crescent unit of 14-cu.yd. capacity, has been shipped by Sauerman Bros., Chicago, to Brooks-Calloway Co. for building Mississippi River levees with tower-cableway.

TRUCKS RUN BACKWARD UPHILL, forward downhill, when loaded by Stroud elevating grader on Douglas County (Neb.) road-widening job of Yant Construction Co., of Omaha. In sending the accompanying photograph, A. C. Thomas, general manager of the Stroud Road Machinery Co., writes as follows: "Your article in the October, 1931, issue of *Construction Methods*, describing how motor trucks ran backward in making earth fills for highways in Tennessee, reminded me of an oddity I saw recently involving the same method of operation. The advantages of this method of loading were: First, turning of truck in narrow roadway was eliminated; second, loaded truck going uphill traveled in gear that gave most power; third, this arrangement caused least danger to traffic, as driver of tractor and driver of truck faced in opposite directions and could watch vehicles approaching from either end of job."



DOUBLE DUTY in pushing and pulling earth simultaneously is performed by this Caterpillar tractor equipped on front end with bulldozer blade and on rear end with "cowdozer" scraper developed by R. G. LeTourneau of Stockton, Calif.

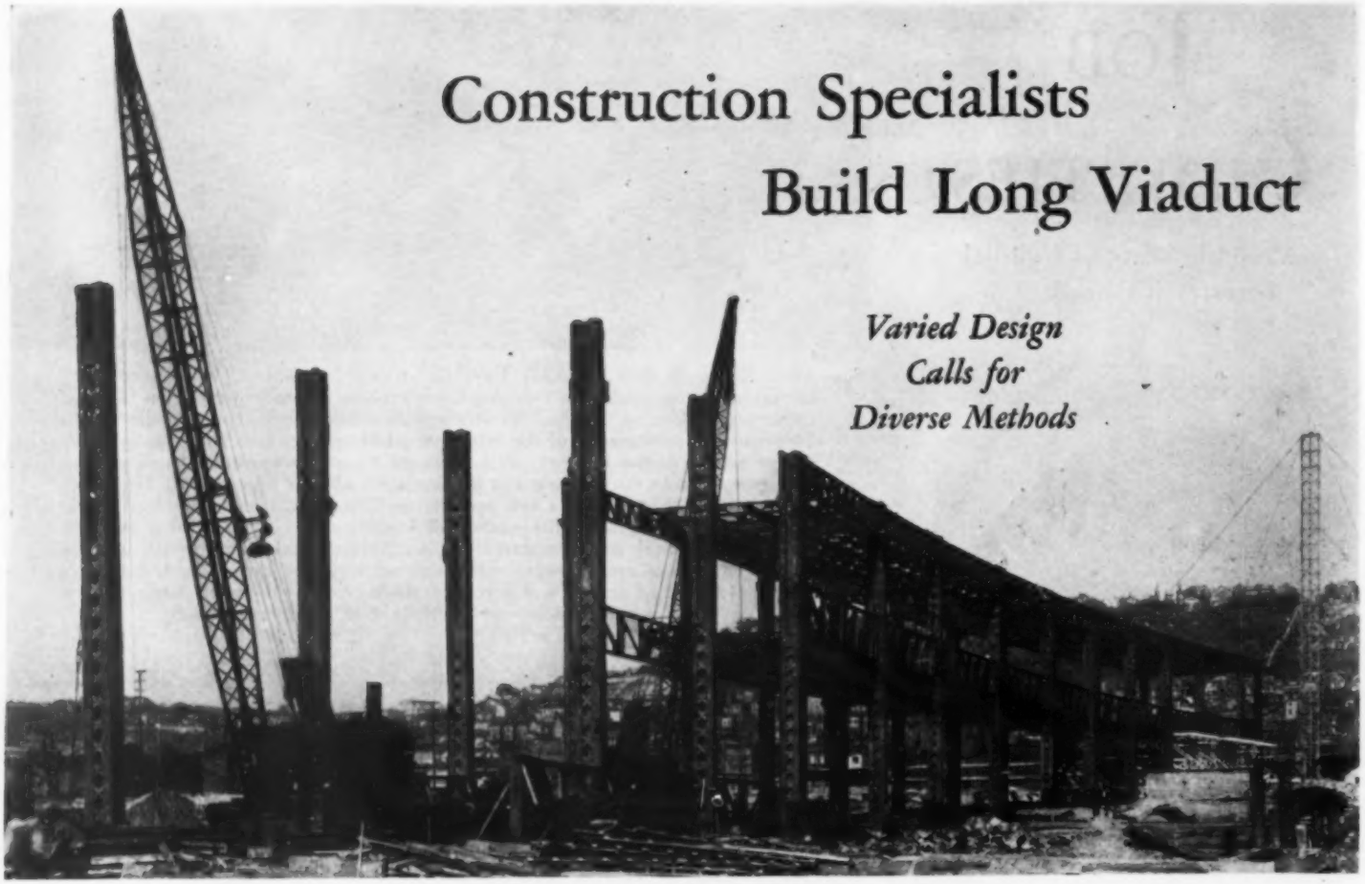


TO DIRECT AIR TRAFFIC red brick paving of new bridge over Maumee River at Napoleon, Ohio, carries name of town and north arrow outlined in white brick. Letters are 29 ft. high.

TWO-LEVEL CITY, Bahia, in northern Brazil, solves problem of vertical transportation between business and residential districts by installing Otis express elevators in 240-ft. tower.

Construction Specialists Build Long Viaduct

Varied Design Calls for Diverse Methods



TWO LOCOMOTIVE CRANES erect 5,000 tons of structural steel (later to be incased in concrete) in 3 months.

A DIVERSITY of methods entered into the construction of the Western Hills Viaduct, the major portion of which was built by the MacDougald Construction Co., of Atlanta, Ga., and nine subcontractors for the Cincinnati Union Terminal Co., the Baltimore and Ohio R. R., and the city of Cincinnati. A minor contract for the west plaza was let to the Folwell Engineering Co., of Chicago, and the entire project was completed at a total cost, including land, of approximately $3,500,000 in time for opening on Jan. 16, 1932. A double-deck continuous-frame structure 3,300 ft. long, partly of reinforced concrete and partly of concrete-incased structural steel, with foundations of cast-in-place concrete and steel-pipe piles, and with two concrete arches included in its length, the viaduct presented a variety of design which demanded equal diversity in methods of construction.

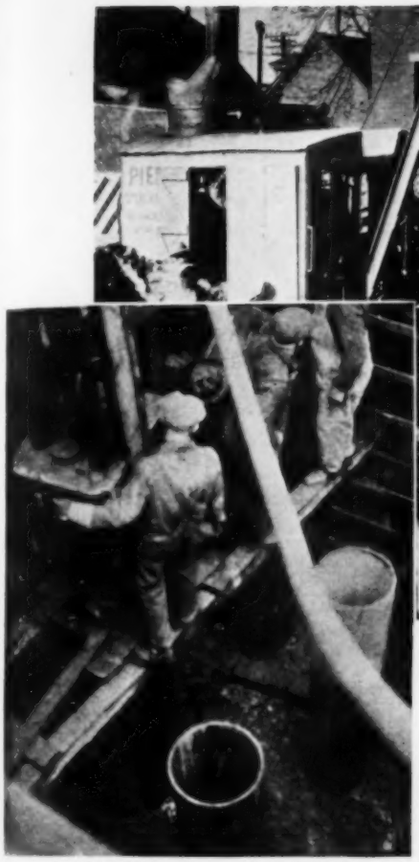
OPEN-END STEEL-PIPE PILES, driven to rock, form foundation for piers in vicinity of Mill Creek. Footings of arch abutments will be poured on pipe piles in cofferdams. Truck mixer on trestle has just delivered load.

Description of Viaduct—The Western Hills viaduct crosses Mill Creek and the area being developed by the Cincinnati Union Terminal Co.; it will replace two viaducts and two streets which have to be destroyed to make way for the terminal project. The structure will afford a high-speed connection between the central portion of the city and the residential district west of Mill Creek.

Bridge traffic is divided between the two decks according to class, the upper level being for passenger automobiles and the lower for trucks and trolley cars. Pedestrians use two 6-ft. cantilevered sidewalks on the upper deck.

Extent of Contract — Legal delays prevented the letting of 168 ft. at the west end in the original contract. This contract, awarded to the MacDougald Construction Co. for a total bid price of $1,721,002, provided for construction of a portion 3,138 ft. long and included 58 pairs of piers, four of which support concrete arch abutments; 33 concrete bents; and 21 steel bents incased in concrete.

The two concrete-arch spans, both of which were included in this contract, are more than 130 ft. long, c. to c. of piers. Length of concrete-girder and steel-girder spans varies, but it aver-



TIMBER FRAME guides pipe piles driven in bottom of sheeted pit, steam hammer being handled on load line of crane. To drive piles on surface of ground, cranes use swinging leads.

JET of compressed air and water excavates muck from inside pile after driving of each pipe section.

AFTER BLOWING PILE DRY with air jet, workmen place concrete handled from hopper by special bottom-gate bucket.

ages more than 50 ft., c. to c. of bents. Columns of typical bents are spaced 45 ft. 5 in., c. to c. Height of the decks above the surface of the ground naturally shows great variation; the roadway on the upper deck across the area being developed by the terminal company is 60 to 70 ft. above the original ground surface. Where the two decks parallel each other, the top of street car rail on the lower deck is 21 ft. below crown elevation of the upper roadway.

Foundation Design—Piers 1 to 14, inclusive, between Central Parkway and Spring Grove Ave., rest on concrete spread footings. Piers 17 to 43, inclusive, rest on 4,269 MacArthur piles of two types, cast-in-place concrete and composite (wood below groundwater level, concrete above). The original design of the foundations for piers 15 and 16, carrying the Spring Grove arch, and for piers 44 to 51, which include the Mill Creek arch, had to be changed.

It was the original intention to use MacArthur piles at the Spring Grove arch and open steel caissons, carried to rock, for the piers in the vicinity of Mill Creek. Subsoil conditions at Spring Grove Ave. and quicksand at Mill Creek caused the engineers to change the designs from cast-in-place friction piles and open caissons to steel-pipe column piles for all these piers. A subcontract was awarded to the Pierce Steel Pile Corp., of New York City.

Concrete and Composite Piles—The 4,269 piles driven by the MacArthur Concrete Pile Corp., of New York City, varied in length from 20 to 70 ft.; more than three-fourths of the number are 45 to 50 ft. long. Practically all the piles are composite. All of the MacArthur piles were driven with four of the contractor's standard roller-type steel drivers having 60-ft. leads. Each driver was equipped with a Vulcan No. 1 steam hammer and a Lidgerwood 40-hp. two-drum steam

WESTERN HILLS VIADUCT is double-deck structure crossing terminal area, two lines of B. & O. R.R., and Mill Creek. Top deck, for passenger automobiles, connects with Central Parkway at east end; lower deck, for street cars and trucks, with Spring Grove Ave. At west end, two-branch ramp from lower deck puts trucks on street at same level with motor cars; trolley tracks drop to lower level. Old Harrison St. viaduct is to be removed.

TO PUSH PILES down to grade, if they have risen after being driven, and to test all piles for designed load, MacArthur driver (below) is loaded with pig iron. By placing steel core (left) against top of pile and pulling down on core with two lines attached to timbers under I-beam stringers, driver applies 40-ton load to each pile.

hoist engine. The leads were of the MacArthur standard design which allows a 15-ft. extension to be added at the top. Links inserted at the hinge to the bedframe inclined the leads for driving various batters.

A solid steel core, illustrated by one of the photographs, formed the hole for the cast-in-place concrete shaft. In constructing a composite pile, the core first was driven below the bottom of the concrete portion of the pile and then was withdrawn to allow the insertion of the wood pile. The wood pile was fitted at the top with a 12-in. tenon of smaller diameter. This tenon acts as a dowel between the wood and concrete portions of the pile. The steel core, at its lower end, has a cylindrical depression which fits over the tenon.

Using the steel core as a follower, the contractor drove the wood pile to a resistance of six blows per inch. The core was again withdrawn, and a corrugated steel casing of 14½-in. outside diameter was dropped into the hole and locked to the tenon of the wood pile by a special pin-and-groove connection. With this connection made, the steel core drove the wood pile and attached casing to final grade. Concrete was placed in the corrugated casing by a special bucket narrow enough to be hoisted between the leads.

Steel Piles—The 341 open-end steel-pipe piles driven by the Pierce Steel Pile Corp. have a total length of 23,550 lin.ft. Individual piles range from 55 to 100 ft. deep. They were made up of 20 in. O.D. steel pipe ½ in. thick in 22-ft. average lengths, were excavated by a compressed-air-and-water jet after driving, and were filled dry with concrete. After the piles had been cut off at the proper elevation with an oxy-acetylene torch, the concrete cores were cleaned and the footing was poured. All pipe piles extend to rock.

Three cranes, a P&H gasoline with a 50-ft. boom, an Erie gasoline with a 40-ft. boom increased to 70 ft. by a steel extension, and an Erie steam with a 40-ft. steel boom augmented to 60 ft. by the addition of a 20-ft. wood jib, handled both pipe and hammers. An auxiliary steam boiler was used to operate the hammer on each of the gasoline cranes.

As the driving of each section of a pile was completed, the soil inside the pipe was blown out by a jet of water mixed with compressed air. The air was delivered to the hose at a pressure of 100 to 115 lb. per square inch. An Ingersoll-Rand two-stage compressor, with a capacity of 850 cu.ft. of free air per minute, driven by an Allis-Chalmers 125-hp. electric motor, furnished the air for blowing operations at the piers in the vicinity of Mill Creek. At Spring Grove Ave., a battery of three portable compressors supplied air to a group of small receivers feeding one discharge line.

Hard clay and an 8-in. stratum of limestone presented difficulties in driving the pipe piles at Pier 15, on the east side of Spring Grove Ave. The contractor broke the limestone rock for half the piles by dropping a steel rail inside the pipe. This process was laborious and time-consuming. A more successful method was used on the remaining piles. The H. C. Nutting Co., of Cincinnati, was engaged to core-drill a hole for each pile through the rock layer. The drill shaft operated inside the pipe after the pipe had been driven to resistance.

Concrete—The two pile subcontractors and the general contractor bought their concrete from commercial plants which delivered it in mixer or agitator trucks.

Concrete for the MacDougald Construction Co. and for the Pierce Steel Pile Corp. was mixed, either in transit or at the job, by Jaeger truck mixers.

Concrete for the MacArthur piles was mixed at a central commercial plant and was hauled to the job in truck-mounted rotating drums which served to keep the concrete uniform and workable until it was delivered.

Concrete Construction—The MacDougald Construction Co. placed 12,250 yd. of foundation concrete and

AGITATOR TRUCK has 2-yd. drum mounted transversely on truck. Drum is charged and discharged through same gate.

32,605 yd. of structural concrete. More than 8,000,000 lb. of reinforcing steel entered into the construction. An Insley structural steel compartment tower 150 ft. high and two Insley mast-hoist plants, one, 180 ft. and the other 120 ft. high, elevated the concrete from the ground and delivered it through Insley chutes to the viaduct. The compartment tower was equipped with a 1-yd. bucket and each of the mast hoists with a ¾-yd. bucket.

An economical falsework system was designed for repetitive use, with allowance for irregularities in the clearances under the various spans. The system consisted of sectional timber towers made up with 8x8-in. posts, the sections being of various lengths which could be combined to obtain any desired height. A job shop was equipped to produce economically sturdy panel forms for repeated use.

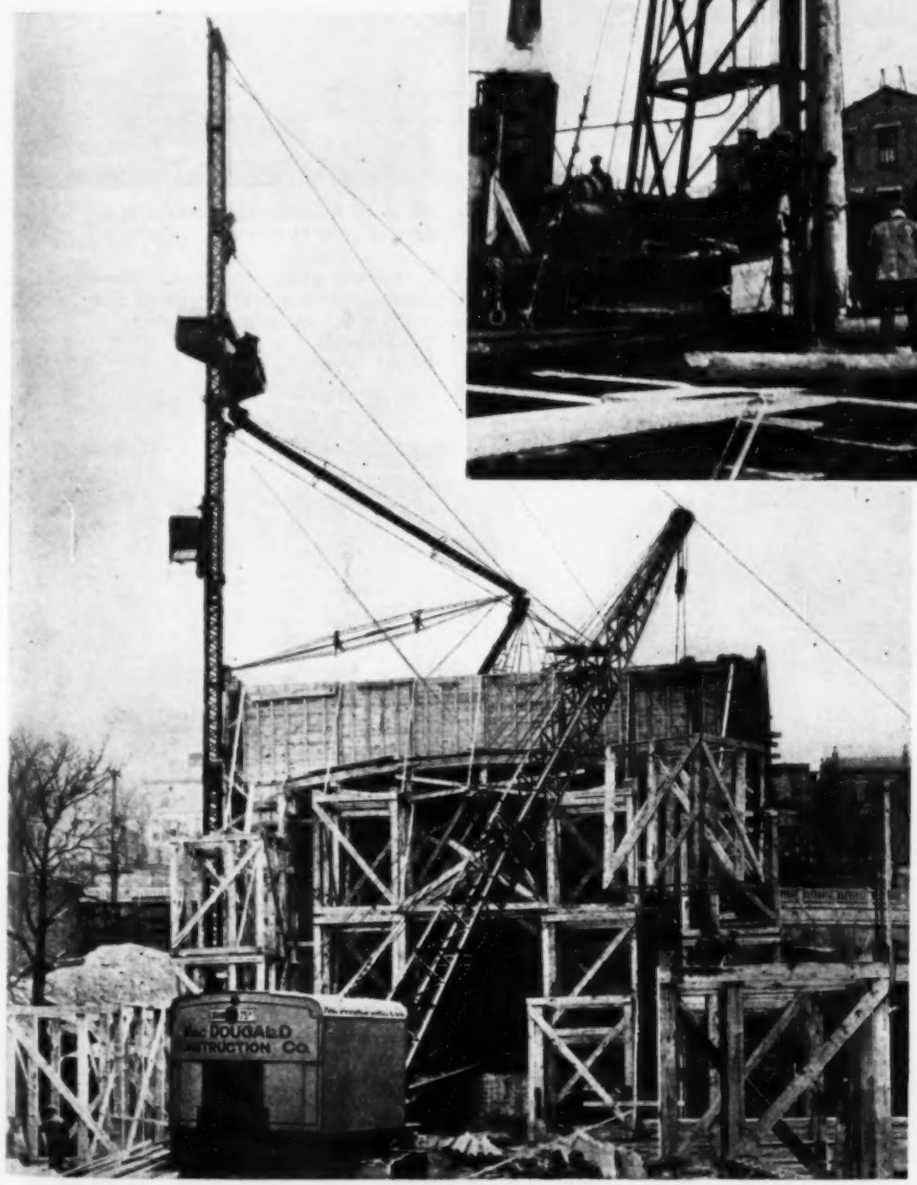
To handle falsework, forms and reinforcing steel, the contractor had two Lorain gasoline cranes, one with 45-ft. boom and the other with 70-ft. boom, and an Osgood steam crane with a 45-ft. boom.

Structural Steel Erection—Columns up to 68 ft. high and girders and floor beams were received on the job by the field crew of the McClintic-Marshall Corp., steel subcontractor, already fully fabricated. Assembling and erection of the 5,000 tons of steel were completed in 3 months with two Bay City steam locomotive cranes, a 60-ton with 90-ft. boom and a 75-ton with an 80-ft. boom, and twelve riveting guns, operated by two Chicago Pneumatic 320-cu.ft. diesel-powered air compressors. All steel was incased in concrete by the general contractor.

Administration—The city of Cincinnati, the Cincinnati Union Terminal Co., and the B. & O. R.R. are sharing the cost of the Western Hills viaduct. Design and supervision of construction are by the Cincinnati Union Terminal Co., with Henry M. Waite as chief engineer; George P. Stowitts, construction engineer; Pusey Jones, engineer of design; S. E. McGavran, assistant engineer; and George H. Wells, district engineer. Those in charge for the general contractor and the three principal subcontractors were: MacDougald Construction Co., Thomas M. Poyner, project manager, and E. O. Donaldson, construction superintendent; MacArthur Concrete Pile Corp., George V. Allyn, superintendent; Pierce Steel Pile Corp., B. R. Foster, superintendent; and McClintic-Marshall Corp., G. C. Kinneman, foreman.

TWO STEEL DRIVERS, with 60-ft. leads, put down wood-and-concrete composite piles. Solid steel core has been lifted into leads of driver at right. In foreground, at left, workman has attached hoisting line of second driver to corrugated shell.

WOOD PILE *(below)* is lowered into hole formed by steel core. Note tenon at top. Annular sheet-steel collar on shoulder of pile around tenon protects top of pile during driving by steel core, used as follower.



SECTIONAL FALSEWORK TOWERS are erected by crane. Tower sections of various lengths are combined to provide desired height of falsework.

Deep-Water River Crossing by Gas Main
COMPLETED IN 2 DAYS

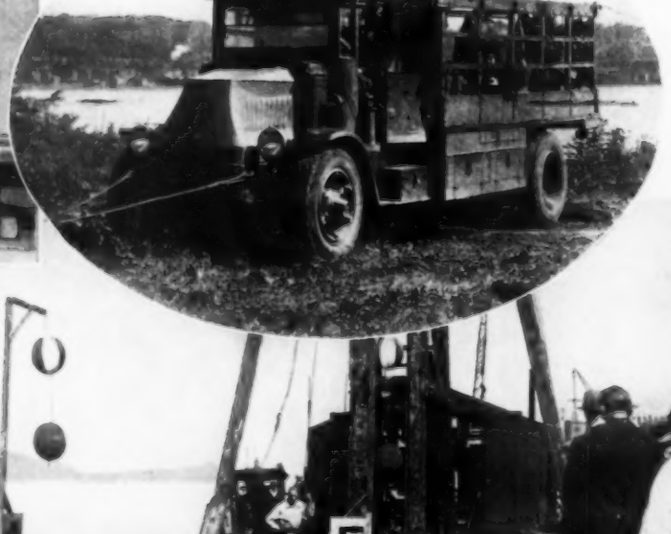
IN LESS than two days' time and without interference to navigation, the Central Hudson Gas & Electric Corp., of Poughkeepsie, N. Y., laid an 8-in. submarine steel gas main 3,200 ft. long across the Hudson River in water from 50 to 80 ft. deep. The pipe, in 40-ft. lengths with bituminous enamel coating, was first acetylene-welded into six sections on blocking convenient for launching, equipped with pontoons at 80-ft. intervals, and then pulled across the river by cable from a winch on the opposite shore. As the rear end of each section of pipe line reached the river the next section was welded to it with the aid of a 9-in. pipe sleeve. Design features of the pipe line were developed, under the direction of A. L. Colligan, by W. A. Schuerman, civil engineer, who supplied the accompanying notes and photographs. Construction by the company's forces was done with T. A. Corby as superintendent. Telephones at key points enabled operations to be coordinated from a central point.

1 **LONG SECTIONS of welded pipe are carried on blocking to facilitate launching into river.**

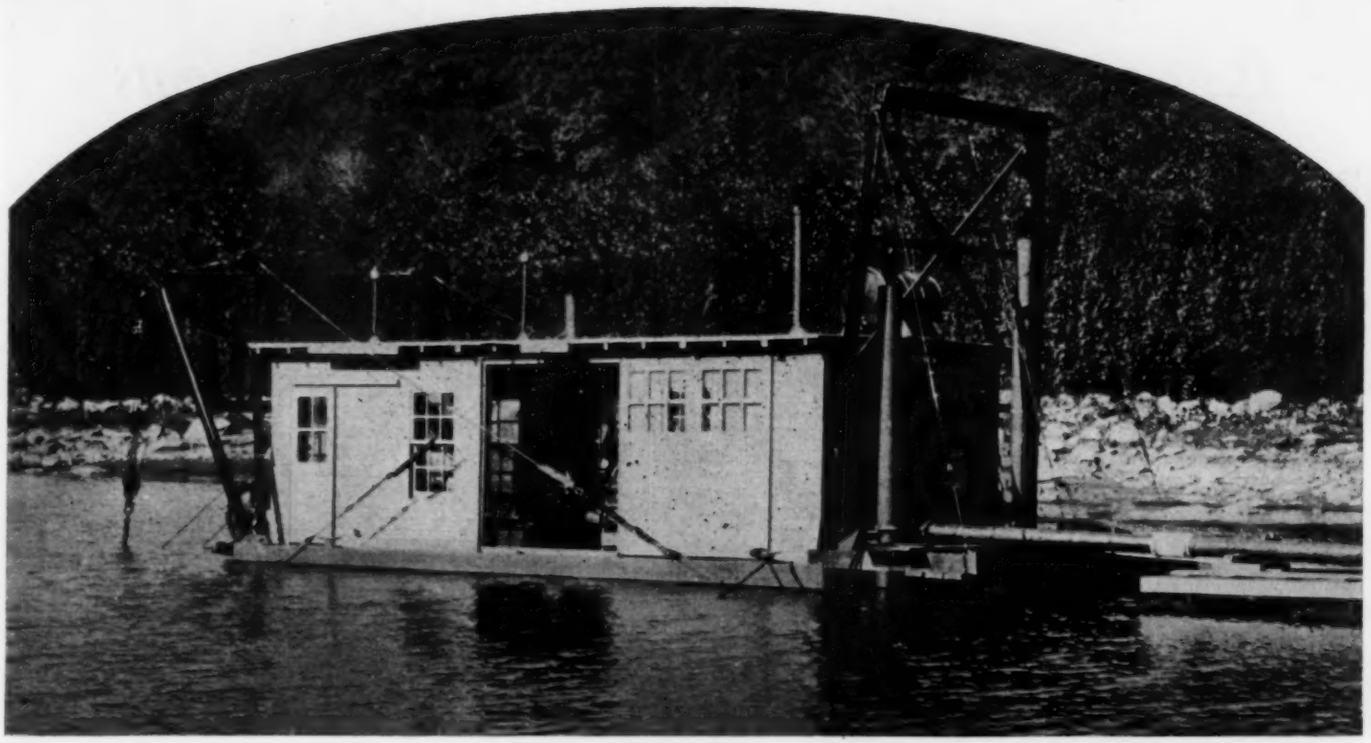
2 **LAUNCHING BEGINS. Pontoons attached at 80-ft. intervals have carrying capacity slightly less than weight of pipe in water.**

5 **TRUCK WINCH *(below)* pulls pipe across river. Operator has telephone connecting with crews on four anchored barges and with supervisor at point of launching.**

3 **AS BACK END of each section of 8-in. pipe reaches shore line next section is welded to it and reinforced with 9-in. pipe sleeve.**



4 **SURFACE FLOAT *(right)*, equipped with hand winch, replaces one of the pontoons at 320-ft. intervals to permit pipe to be suspended 35 ft. below surface, leaving clearance for navigation. Pipe is guided across river by ropes from four anchored barges.**



MIDGET DREDGE

Designed for Truck Transport to Land-Locked Waters

A NEW "vest pocket" suction dredge, the smallest ever built with cutter machinery, is the latest acquisition of the Division of Water, Department of Public Works, Newark, N. J. Its electrically-welded steel hull, though only 31 ft. long, with 14-ft. beam and 2-ft. draft, is trussed internally like a bridge and carries a full size 6-in. suction of standard design. The hull is made in two pontoon sections, to be bolted together in the water, and is light enough to be trucked "knocked down" to any land-locked water supply and strong enough to withstand the rigors of launching. It was built by United Dry Docks, Inc., of New York.

This equipment, which will dig to a depth of 10-ft. below water, was supplied by Pierce J. McAuliffe, New York, and is now removing 26,000 cu.yd. of mud, sand and leaf mould from Macopin intake reservoir.

Reservoir maintenance at Newark is in charge of James W. Costello, chief engineer of the Board of Public Works and his associate, Herman Rosentreter, engineer of the Division of Water.

Hull—The dredge hull consists of two sections, each 31x7x3 ft. which were transported by truck, launched into the reservoir and bolted up, making one hull 31x14x3 ft. upon which pump and all other dredge equipment were installed.

Pumps and Piping—The hydraulicking equipment consists of a gasoline engine driven pump, delivering 1,000 gal. per minute, with three 1¼-in. nozzles at 92-lb. pressure. The engine is a 6-cylinder, 4¼x6-in. unit, rated at 90 hp. Equipment also includes about 2,500 ft. of piping with necessary fittings, high pressure hose lines and nozzles. The area to be scoured with the three nozzle streams was so extensive and the amount of deposit to be removed at any given place so small, that manual operation was clearly indicated. The bottom cleaning by this method has progressed with great rapidity and the completed portion gives almost the appearance of having been scoured.

The dredge pump is 6-in. suction, 8-in. discharge, of the Morris Machine Works heavy-duty type, consisting of an outer casing and a complete inner casing of manganese steel. Manganese steel also was used for all wearing parts of the pump. The pump is direct-connected to a 112-hp., 6-cylinder gasoline engine with 6x7¼-in. cylinders. The pump, designed and tested for 1,250 g.p.m. against 125-ft. total head, has a capacity up to 3,200 g.p.m. against 20-ft. head.

Maneuvering is accomplished with a 5-drum winch, driven by a 4-cylinder gasoline engine. An engine of identical size drives the cutter equipment which is of standard Morris Machine Works design, as is the pump.

The general service centrifugal pumping unit has capacity of 60 g.p.m. against total head of 75-ft. and is driven by a 3-hp. air-cooled engine.

A-frame, spud frame and gallows frame of the dredge are of steel. The wooden deck house is of sectional construction, readily disassembled for removal to other locations as required.

The discharge piping is 8 in. throughout and consists of fifteen 30-ft. pontoons, two pontoon elbows, two 10-ft. pontoons and 1,320 lin.ft. of 8 in. shore piping. All piping was made by the Naylor Pipe Co. of Toncan Iron spiral weld. The short piping has Victaulic couplings.

Bad Ground and Heavy Train Movements Complicate

Enlargement *of Single-Track* Tunnel

[First of a series of articles on main-line tunnel improvements by the Chesapeake & Ohio Railway]

SCALING TOP AND SIDES of old tunnel section to make room for timbering and blasting shield.

FOR several years the Chesapeake & Ohio Railway has been carrying out one of the most extensive main-line betterment programs ever undertaken. An outstanding feature of this program is a series of tunnel changes on that part of the main line through the Allegheny Mountains in Virginia and West Virginia.

In some cases tunnels have been replaced by open cuts, as was done with the Ona tunnel just east of Huntington, W. Va., by methods described in *Construction Methods* of March, 1930, pp. 34-37. Some existing single-track and double-track tunnels have been enlarged under traffic to full-size double-track bores. Several new single-track tunnels have been driven adjacent to old single-track tunnels which it was impracticable to enlarge or remove.

One of the outstanding projects in the way of enlarging an existing single-track bore to a modern double-track section is the 1,894-ft. Stretchers' Neck tunnel about 75 mi. west of the summit of the mountains. When this tunnel was built in the early '70s, great difficulty was experienced for more than 300 ft. in from the west portal because of an exceptionally bad slide of great extent. The rest of the tunnel was driven through dense sandstone.

From excellent records made at the time the original work was done, it appears that the whole face of the mountain back to the face of the ledge

BLASTING SHIELD advances into portal of old tunnel. Steel plates on top were turned over and laid on the roof as added protection against shots.

INTERIOR OF TUNNEL. Timbering of enlarged section is in place, with blasting shield over main-line running track. Drift for advancing wall plate of timbering appears above ladder at left.

RAILROAD OFFICIALS AND CONTRACTORS inspect work on removal of old tunnel lining at west end. (Left to right) L. J. DRUMHELLER, division engineer; J. H. EAST, of Piper & East; P. L. GRAVES, resident engineer; T. H. ALLEN, division superintendent of bridges and buildings; H. M. STANLEY, inspector; W. L. PIPER, of Piper & East, and JOHN CASCIE, in charge of traffic.

sandstone got into motion. Only by working headings from the foot of a shaft sunk to grade some distance from the west portal was it possible to get the bore through. Even with that method the placing of the heavy brick lining used must have been a serious problem, judging from the conditions uncovered by the recent work.

As a matter of fact, the old slide on the side of the mountain above the west portal had never really been stabilized. It had been held in place by interlining the old brickwork at various times and by other expedients. But when plans were made to get a second track through the ridge, it was evident that a new bore would meet the same trouble back to the solid rock. The decision therefore was made to take off the whole side of the mountain back to the ledge rock. At the same time, the old bore was to be enlarged to a modern double-track section, working from the east portal.

Nearly 500,000 yd. of earth and loose rock had to be removed from above and around the 320 ft. of the tunnel between the west portal and the ledge rock. The plan also called for the removal of that much of the old tunnel as soon as the shifting, treacherous slide surrounding it could be stripped. All of these operations had to be handled with as many as 70 train movements in 24 hr. This traffic includes many long coal trains moving slowly. There are thus few periods when the line is free.

As coal was cheap and water was abundant at the site, Piper & East, of Bluefield, W. Va., sub-contractors on this part of the project, used three steam shovels. With a cut more than 900 ft. from rim to rim and with side slopes nearly 700 ft. in length, the material was removed in a series of lifts that ranged in depth according to the local conditions.

High up on the mountain side holes for blasting were put down from 15 to 35 ft. with well drills. After the cover over the old tunnel was reduced to the point where heavy shooting was no longer safe, all drilling was done with jackhammers. Loading and shooting at all times had to be handled with great care to avoid a fall of the old lining. When the stripping got down near the lining, the haunches of the latter were left braced with earth on

500,000-YD. CUT over old west portal is made to permit removal of 320 ft. of old tunnel at that end.

SHOVEL MUCKS SPOIL in tunneling operations. Pile of muck in foreground is from scaling work on top and sides of old tunnel. When shovel is mucking from enlargement excavation, it is turned other way and loads into cars on service track at left.

both sides until the top of the masonry could be cleaned off by hand.

Removal of the lining was handled back for 100 ft. from the portal without any shoring of the masonry. Holes were drilled closely together in 20- or 30-ft. sections of the lining and lightly loaded. The masonry was then shot down in a section of the length mentioned on the main-line track at a time when traffic was the lightest. Working with one of the shovels at top speed, the spoil was removed fast enough to avoid much delay to train movements.

Although no accidents resulted to traffic from this scheme of operations in the first 100 ft. of the lining removal, the rest of the lining was not in condition to make that procedure entirely safe. The remaining 99 ft. in length of the lining was therefore lined with steel centering carrying liner plates that fitted snugly against the inside of the old brick tunnel arch.

While work on the west end of the old tunnel was under way, operations were in progress on the enlargement of the remaining 1,580 ft. from the east portal. To protect the heavy traffic on the single track in the tunnel, three sections of traveling steel shields, each 30 ft. long, were provided. These shields were erected at the east portal and run into the tunnel so as to lap well ahead and behind the point where the drilling and shooting required by the enlargement work were in progress.

To provide sufficient clearance for the traffic on the main-line track, the original tunnel section had to be scaled out ahead of the entrance of the shields. This was done by hand from a scaffold car run into the tunnel between train movements. Enough rock also was scaled off on the right-hand side of the old tunnel to permit a line of 12x12-in. timber plumb posts and a wall plate of that size to be set.

With the plumb posts and wall plate set on the right side far enough in beyond the portal, the shield was run in over the main-line track and rock excavation started on the enlargement to the double-track section. The first step in this rock work was to keep a drift ahead for the left-hand wall plate of the timbering of the excavation. With this plate set, a heading of the section of the arch of the new tunnel bore was drilled and shot to a depth of 10 ft. The rest of the excavation was taken out in two benches. The upper bench was handled right along with the heading, being drilled and shot at the same time. The lower bench was kept right up to the first one, but was drilled and shot as a separate operation. Except for some hand work in the heading and on the upper bench, all of the mucking was done with a power shovel.

All shooting had to be done with exceptional care to avoid damage to the shields that would block traffic. Blasting was permitted only when no trains were in the tunnel or shortly due. With the shields, the drilling and mucking could be handled without refer-

ence to the traffic, except that excessive smoke and fumes from locomotives made conditions bad, in spite of continuous pumping of air into the heading from the outside.

To reduce the shock on the shields from blasts to the minimum, holes were closely spaced above the latter. These holes also were fired first with the idea of providing a cushion of loose rock on top of the shield that would lessen the effect of the heavier later charges in the rest of the heading.

As originally built, the shields consisted of structural steel bents and arch rings, spaced 4 ft. on centers on a structural steel base at each side. Mounted in these longitudinal steel bases were traveler wheels running on rails laid on the bottom of the tunnel. The bents and arch rings were lagged with 4-in. plant. Loose built-up steel-plate sections, shaped to the outside of the top of the shield, were provided to take the shock of the blasting directly over the shield.

As the work progressed, it was found necessary greatly to reinforce the original shield design. The shock from the blasting exceeded expectations so much that the shields were occasionally badly bent and damaged. The reinforcing was done by placing 12x12-in. timber bents between the steel bents, with horizontal struts of the same size well distributed over the whole section of the shield.

Thus reinforced, the shields made possible all operations without damage or delay to traffic. No shooting was done, however, when trains were near the tunnel. After each blast the results were checked carefully to avoid any chance of falls later that might cause trouble.

After the tunnel excavation, involving 45,000 yd. of solid rock, is completed, the section will be lined with concrete having a minimum thickness inside the face of the timber lining of 18 in. in the side walls and the arch ring. The floor of the tunnel also will be paved, with a ballast wall along each side.

C. W. Johns is chief engineer of the Chesapeake & Ohio Railway. E. G. Rice is district engineer in charge of the section of the betterment program that includes this project. P. L. Graves is resident engineer.

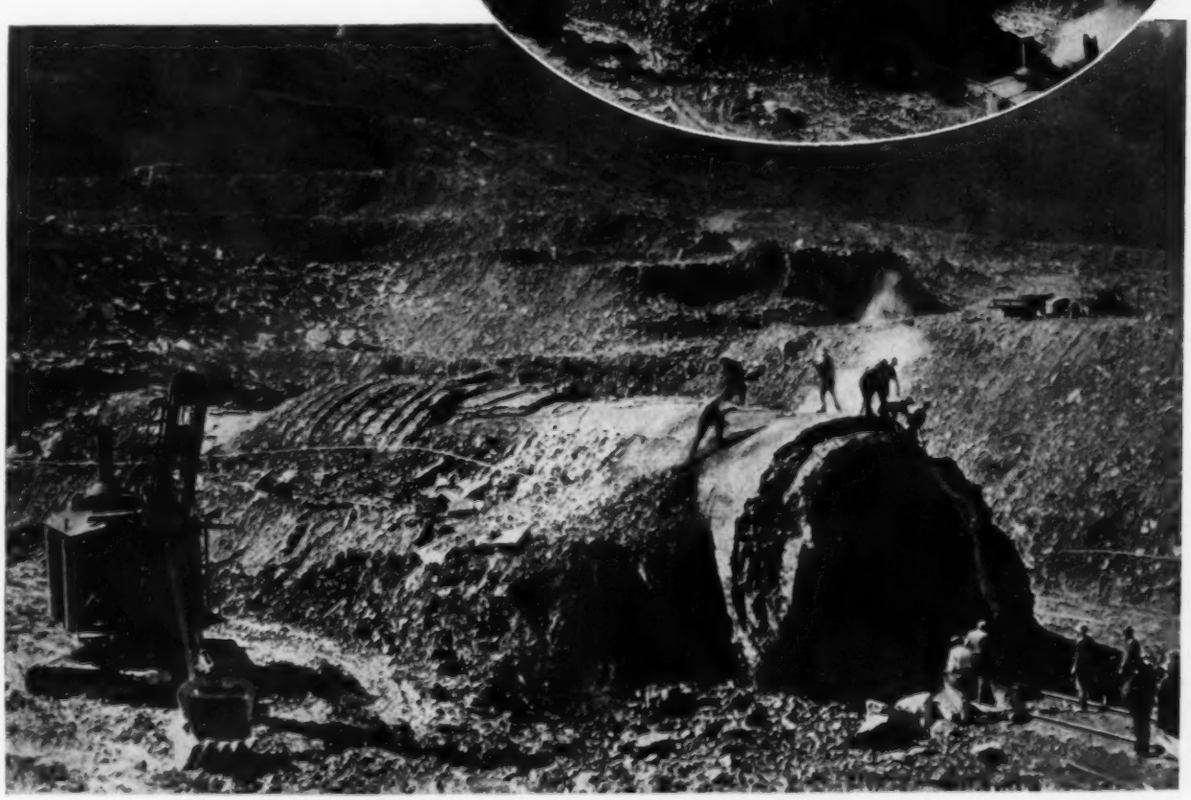
Carpenter, Major Bros. Co., Inc., of Clifton Forge, Va., have the contract for the changes in the Stretchers' Neck tunnel, the enlargement of the section in rock being handled by Boxley Bros. Co., of Orange, Va., with Charles Tullah in charge.

The Next Article

In an early issue will appear the second article in this series on the extensive tunnel changes involved in the Chesapeake & Ohio's main-line betterment program. It will illustrate and describe the enlargement of three short, double-track tunnels just east of the summit of the Allegheny Mountains in Virginia.

The work involved the removal of brick masonry lining, excavation of tunnel section to new dimensions and the pouring of a concrete lining with the aid of movable steel forms and pneumatic placing equipment.

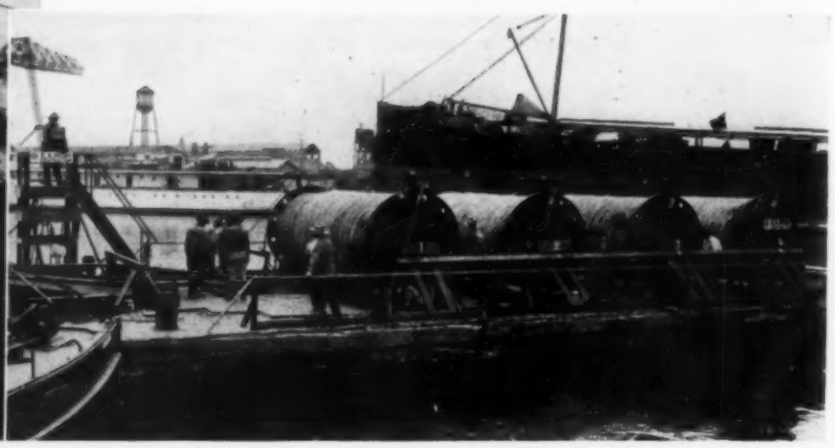
BLASTING SECTION OF OLD TUNNEL LINING *(right)* down on main-line running track. Spoil was quickly removed with steam shovels.



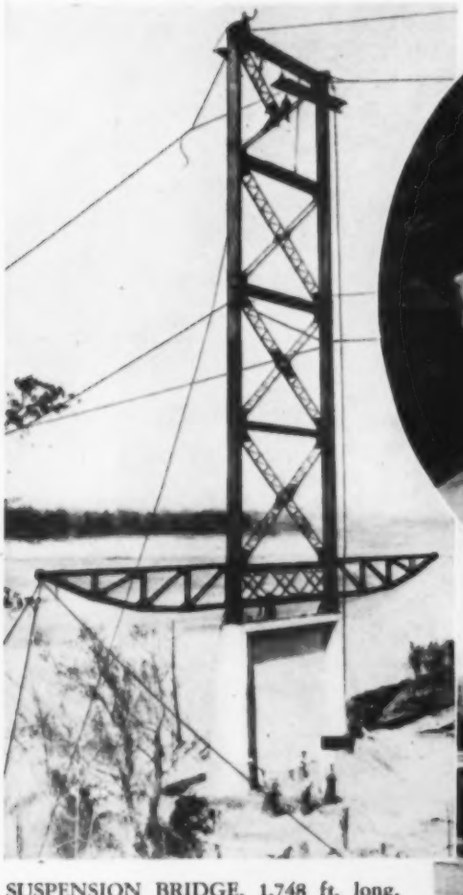
FINAL HAND-STRIPPING of brickwork prior to shooting down section of old tunnel lining. Part of 500,000-yd. cut in background.

Getting Down to

Close-up Shots of Job



FOUR STEEL-ARMORED SUBMARINE CABLES are laid simultaneously in 1 hour 40 min. across 2,700-ft. wide Cerritos ship channel at Long Beach, Calif., by E. A. Irish, Los Angeles contractor, to serve Procter & Gamble soap plant from steam-electric station of South California Edison Co. Cables are payed out from reels on barge rigged with special roller equipment. The barge is towed by one tug and steered by another. Cables are laid in trench dredged 10 ft. deep and 30 ft. wide and later backfilled. Depth of water, 30 ft. Diver follows barge to inspect cable as it is laid.

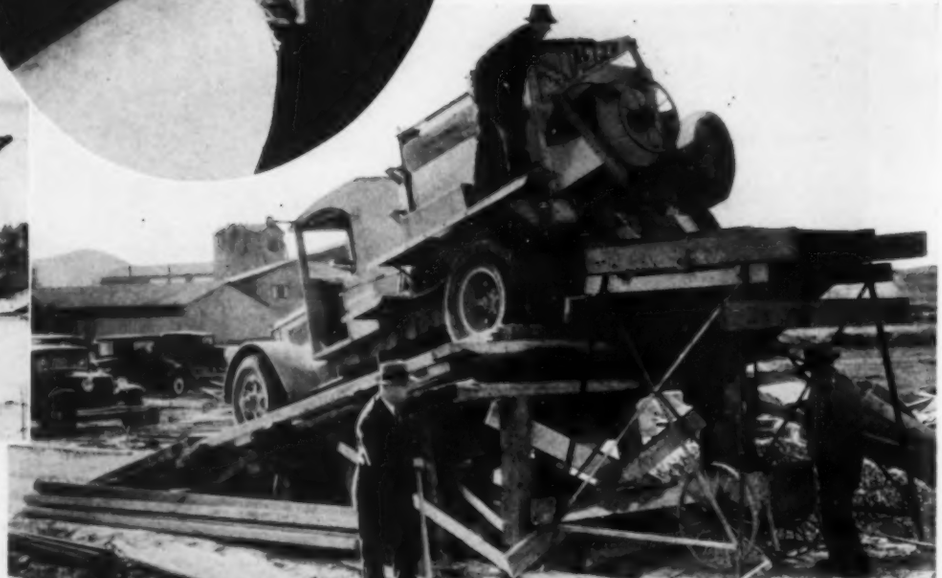


SUSPENSION BRIDGE, 1,748 ft. long, is built by the Southwest L. E. Myers Co. to carry 16-in. pipe line of Lone Star Gas Co. across Red River near Marietta, Okla. Two 2¼-in. main cables and two wind-bracing cables were pulled into place in 5 days working time. During construction the cables were secured with Crosby clips.

Photo—Linde Air Products Co.

WELDS TESTED BY STETHOSCOPE *(left)* of type commonly used by physicians. Soft rubber cap over cone-shaped end piece is pressed against metal. Tapping with light hammer produces uniform sounds for perfect weld and high-pitched, reedy tones for defective weld.

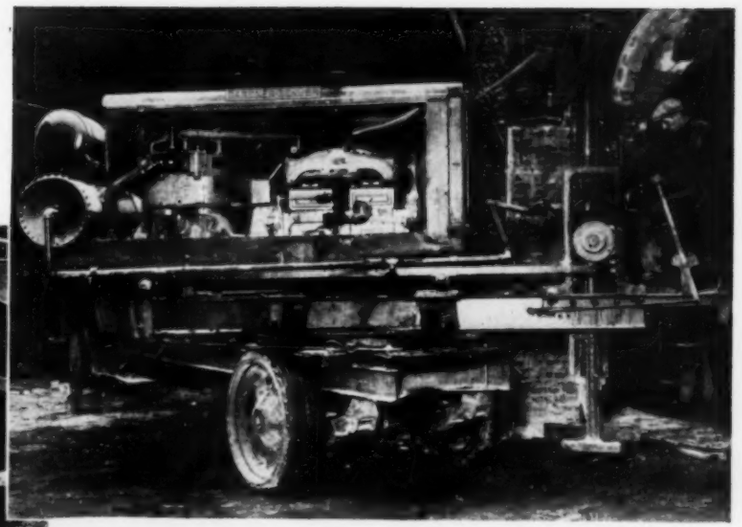
POSITIVE DISCHARGE ACTION *(below)* enables Jaeger truck-mixer, even though backed up on ramp, to deliver contents of drum to hopper feeding concrete carts of Eaton & Smith, contractors, for Ingalls sewer. Concrete is furnished by Ready Mix Concrete Co., of San Francisco.



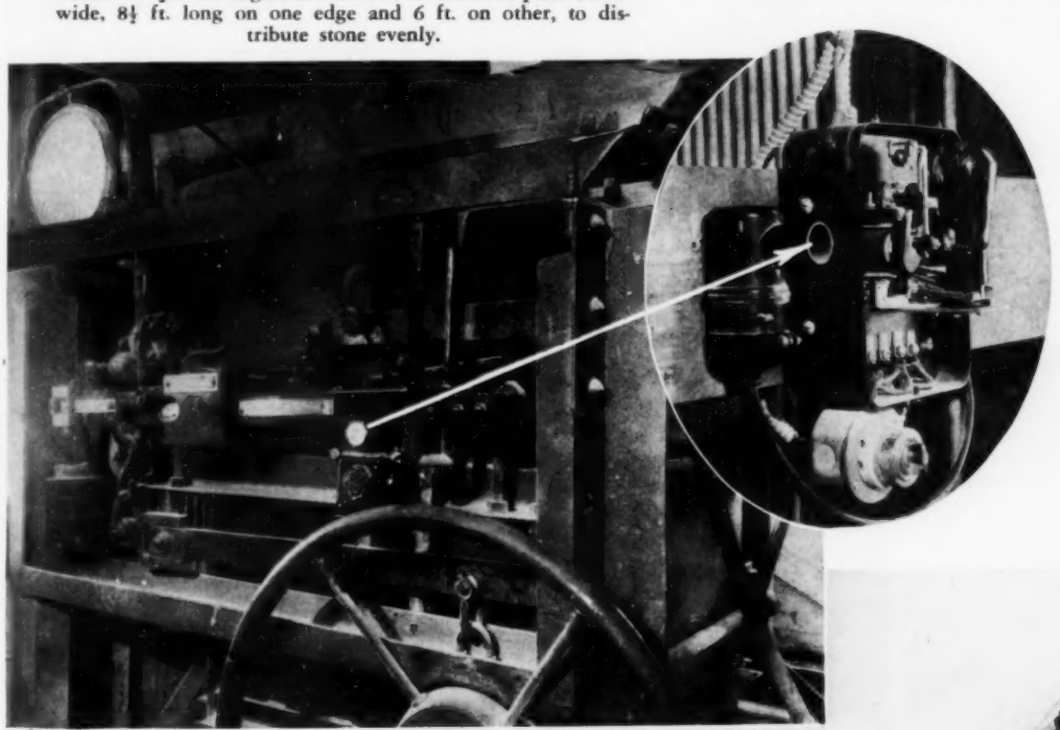
DETAILS

Methods and Equipment

FANTAIL SPREADER, developed by J. R. McDermott, district engineer of West Virginia Road Commission, distributes stone chips from truck on surface-treated roads. Vanes of 1½x2-in. angles are welded to flat steel plate 30 in. wide, 8½ ft. long on one edge and 6 ft. on other, to distribute stone evenly.



PAVEMENT BREAKER operated by air from truck-mounted compressor, enabled Concrete Cutting Corp. of Brooklyn, N. Y., to demolish the main floor of the old Waldorf-Astoria Hotel, New York, prior to the erection of the Empire State Building on the same site. The machine strikes controlled blows, up to 9 tons, at rate of 60 per minute.



ELECTRIC EYE *(above)* automatically insures correct weight of cement for concrete mixture. With the assistance of the General Electric Co., the scales of the N. Ryan Co.'s ready-mixed concrete plant in Brooklyn, N. Y., were equipped with a photoelectric relay. The scale beam is set for the weight desired by means of a poise. A light source is set directly back of the beam and the photoelectric relay is 6 ft. in front of it. Cement is fed into the hopper and, when the proper weight is reached, the beam rises, exposing the light source and energizing the photoelectric relay. This causes the opening of a control circuit to the cement feed motor and automatically shuts off the supply.

BARGE - MOUNTED DRAGLINE *(below)* grades banks of Mississippi River to uniform slope near Keys, Tenn., prior to placing of concrete revetment to prevent erosion. Bucyrus-Erie machine is operated by Army Engineer forces of the Memphis District.

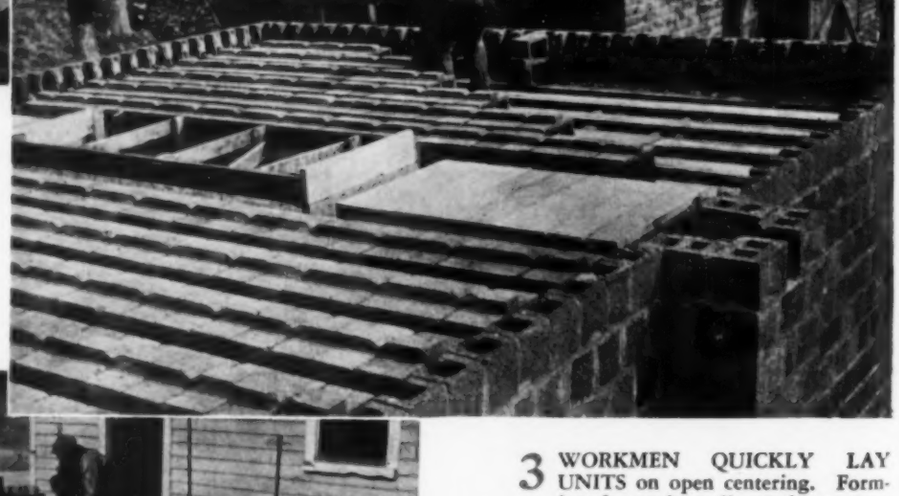
Step-by-Step

Building Concrete-Joist Floor

CONSTRUCTION of reinforced-concrete floors of tile-and-joist design for the Buena Vista High School at Nashville, Tenn., involved the use of a new type lightweight filler unit. As illlustrated in the accompanying photographs, the cinder concrete unit is a two-core tile 16 in. wide and 8 in. long as the unit lies in the floor. It is made in 6-, 8- or 10-in. heights. A rib running the length of the unit is 2 in. high, 4 in. wide and 8 in. long. This rib serves a dual purpose. It is a guide for screeds when the concrete slab is placed and is a nailing base for sleepers when the floor is to be surfaced with wood flooring. The unit, which has walls 1 in. thick, is light in weight,

1 OPEN CENTERING is built to support cinder-concrete fillers in tile-and-joist floor construction, Nashville.

2 TILE ARE LAID in almost perfect alignment at outset. True shape of units permits forming true, even joists.



3 WORKMEN QUICKLY LAY UNITS on open centering. Forming for stair well can be seen at left center.

4 PLACING CONDUITS in connection with tile-and-joist floor construction in which cinder-concrete fillers are used.

Field Methods
With New Type Filler Tile

the 6-in. high size weighing 18 lb.; the 8-in., 20 lb., and the 10-in. unit, 22 lb.

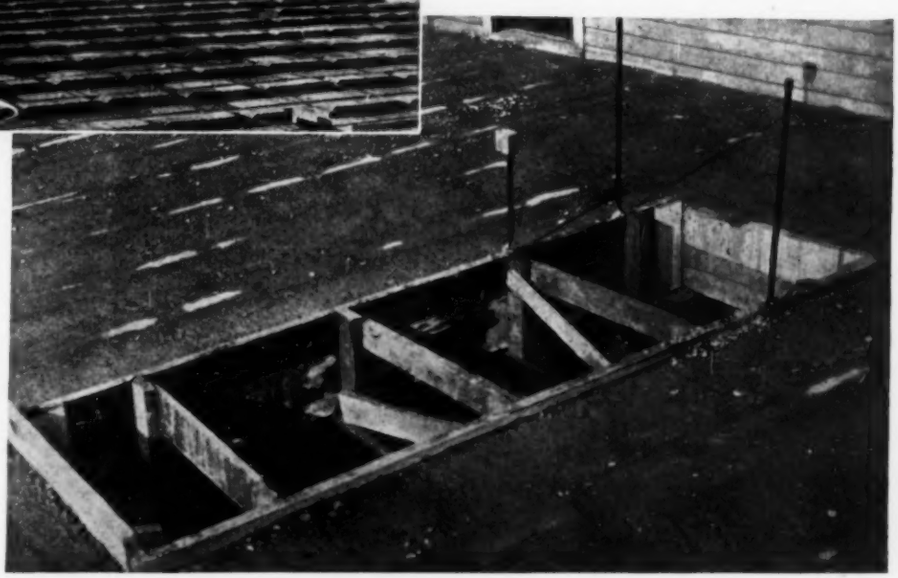
End closures for rows of tile consist of corrugated cardboard, cut to size and furnished by the manufacturer of the units. These are nailed to the cinder-concrete tile just before concrete is placed.

The Nashville high school building was constructed by J. B. Regan & Son, contractors, under the direction of S. R. Underwood, superintendent. The fillers were manufactured by the Nashville Breeko Block and Tile Co., which is affiliated with the National Building Units Corp., Philadelphia.

5 TEMPERATURE STEEL in place. Note notches formed in ribs of units to permit placing of reinforcement.

6 PLACING END CLOSURES consisting of pieces of corrugated cardboard, cut to correct size and furnished by manufacturer.

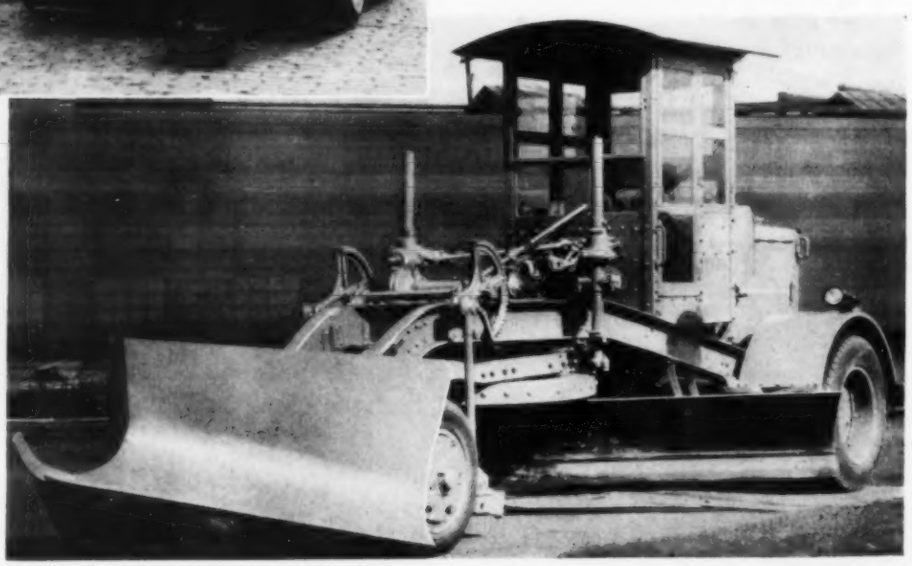
7 FINISHING TOUCHES — nailing on closures for ends of rows of filler units—before concrete is placed for joists and slab.



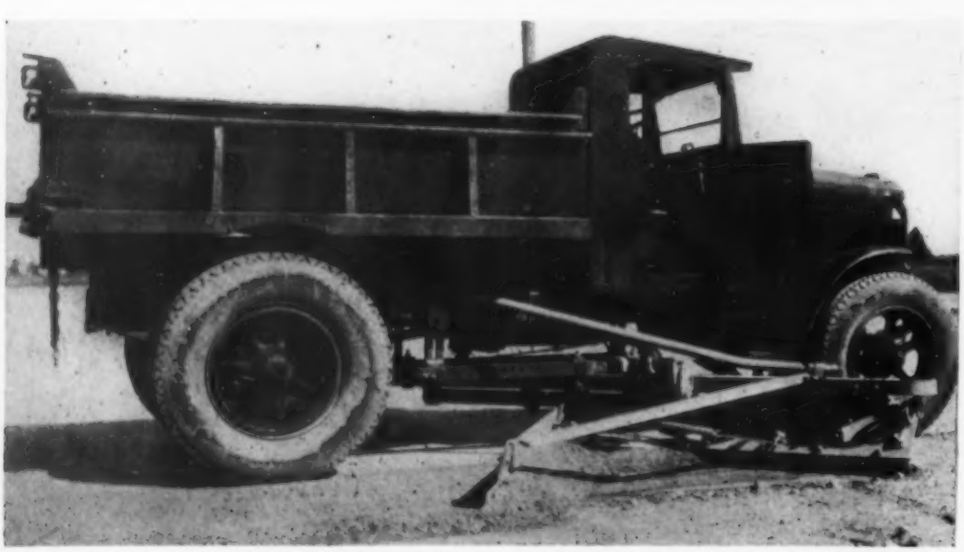
8 CONCRETE SLAB reveals exposed ribs of cinder-concrete fillers to which sleepers can be nailed if wood flooring is used.

NEW EQUIPMENT *on the Job*

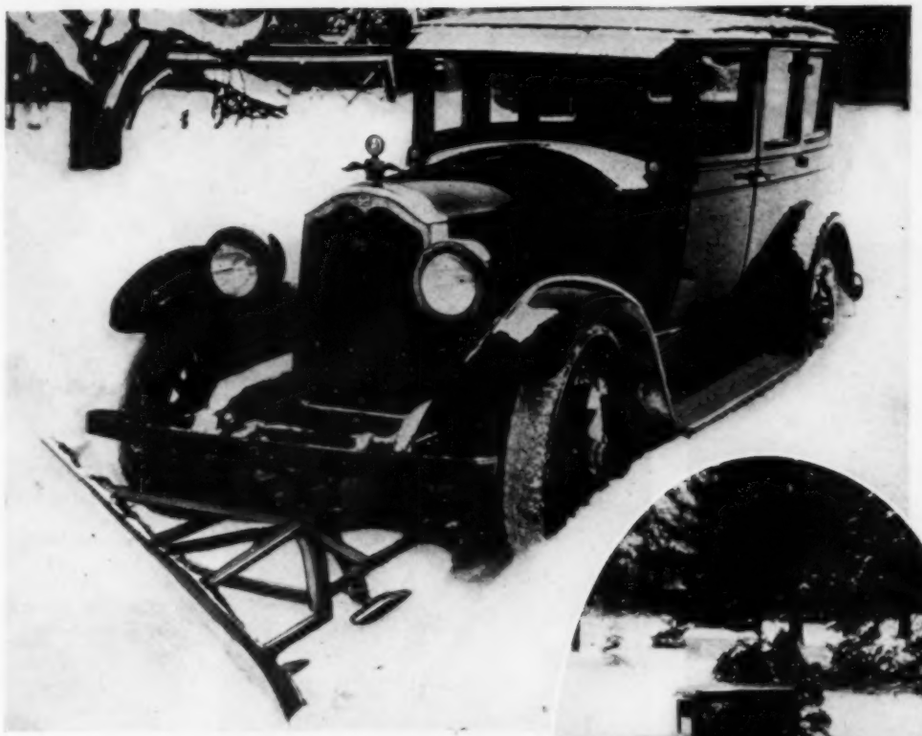
CENTRIFUGAL SUMP PUMP *(left)* designed for general contracting work, including sewer, gas and water-pipe jobs, ditch and trench digging, and for cofferdam, foundation and bridge construction. Motor operated by compressed air and automatically lubricated from reservoir located in cylinder body. Impeller of hardened bronze is dynamically and statically balanced. Pump performs when either partly or entirely submerged. With 20-ft. head, capacity of this Cleco-Deming pump is 142 g.p.m. at 90-lb. and 137 g.p.m. at 80-lb. air pressure. Unit weighs 36 lb. Outlet connection is 2½-in. and air inlet ½-in. standard pipe threads.—Cleveland Pneumatic Tool Co., 3734 East 78th St., Cleveland, Ohio.



SNOW PLOW *(right)* for attachment to one-man road maintenance machine providing all-year-round service unit. Design and position of blade permits snow drifts of appreciable depth to be moved to one side with minimum of effort. Power control permits immediate raising or lowering of blade when obstructions are encountered and saves plow from breakage. Positive traction of both rear wheels prevents slipping, increases hourly coverage of highways, and reduces tire damage. Scarifier attachment of value when streets become coated with frozen snow and ice. Full horsepower of engine available for coping with heavy drifts. — Caterpillar Tractor Co., Peoria, Ill.



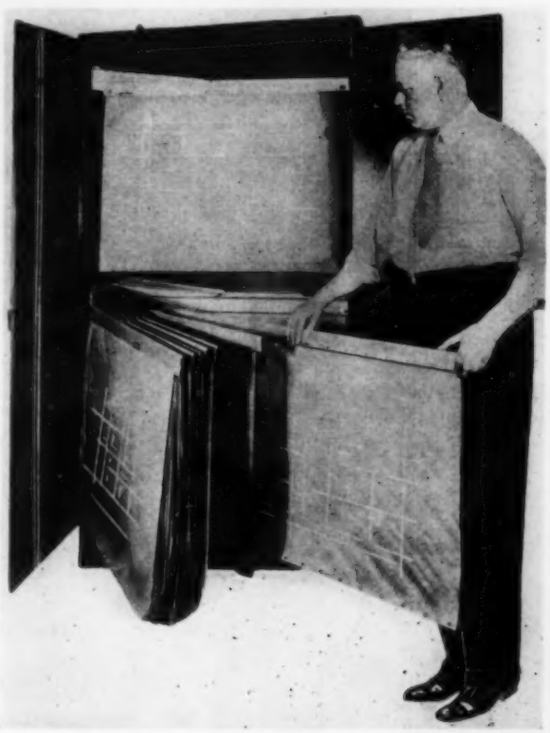
SHOULDER SCRAPER *(left)*, hydraulically operated, for maintenance of shoulders of all types of paved and asphalt roads. Machine is braced to frame of truck and extends out on road shoulder from right side. Moldboard-mounted, curved cutting blade, 4 ft. long, cuts out ruts, rough spots, grass and weeds on road shoulders and brings all overflow material flush with pavement edge. Rear angling blade, 7 ft. long, removes this material from pavement and spreads it evenly on shoulder. Operating speed 7 to 8 mi. per hour. Hydraulic power unit lifts blades providing clearance for transportation. — Willett Manufacturing Co., Ann St. and Turner Ave., Grand Rapids, Mich.



AUTO SNOW PLOW, attached to any type of car, truck or tractor which has an I-beam front axle, clears snow where heavy highway plows are not practical. Single-blade model *(left)* is adjustable and pushes snow straight ahead, to right or to left. It is 78 in. wide, 18 in. high and weighs 225 lb. V-model *(in oval)* divides and rolls snow to both sides at sharp angle. Cuts 6-ft. swath, is 24 in. high and weighs 310 lb. Weight of plow rests on self-steering swivel runners which can be adjusted to carry the plow from ½ to 2 in. off ground. — Shunk Manufacturing Co., Bucyrus, Ohio.

MEDIUM WEIGHT ROTATOR (below) for outdoor rock excavation and down-hole drilling in mines, quarries and on construction work. Weight, 64 lb. Drills 15 to 25 ft. in depth, utilizing 1-in. steel. Equipped with new cam-type front head in which cam and locking bar are employed for retaining steel in chuck. Available in hollow piston, air tube and water tube types. — Sullivan Machinery Co., 400 N. Michigan Ave., Chicago, Ill.

VERTICAL FILING CABINET *(below)* for blueprints, tracings and similar large sheets. Double-tiered case shown is fitted with holders consisting of horizontal channels turned edgewise, which have series of holes in two flanges. Hanger arms are supported in channels with pins on which they pivot. Sheet holders, to which sheets are secured by double-pronged paper fasteners, are made for all sizes of sheets and can be placed on walls, desks, tables or other convenient places.—Acco Products Co., Long Island City, N. Y.



If You Want Further Information

Within the space limits of these pages it is impossible to present complete information about the products illustrated.

The manufacturers, however, will be glad to supply further details if you will write to them, referring to this issue of *Construction Methods*.

FOUR-WHEEL-DRIVE 2½-TON TRUCK *(right)* equipped with dump body and hoist and also latest-type power controlled underbody scraper for road building and maintenance. Motor develops 85 brake hp. and is hooked up to all four wheels through a seven-speed transmission. — Four Wheel Drive Auto Co., Clintonville, Wis.

Present and Accounted For —

A Page of Personalities

COL. W. A. STARRETT, of Starrett Bros. & Eken, Inc., building contractors of New York, was elected last month to the presidency of the Associated General Contractors of America. For years he has been a leading figure in the building industry, and among recent structures his organization has completed are the 85-story Empire State Building and the new McGraw-Hill Building, both in New York City. Col. Starrett is a member of President Hoover's organization for the relief of unemployment.

GEORGE M. BACON, of Salt Lake City, state engineer of Utah, has been chosen as the new president of the Western State Engineers' Association. Mr. Bacon has had an extensive experience in the fields of hydraulic engineering, water works, sewerage and irrigation.

E. A. GAST *(left)*, of Warsaw, Ind., has been re-elected president of the Indiana Highway Constructors, Inc. He is head of the Gast Construction Co. and has been prominently identified with highway construction for a decade or more.

CHARLES W. SHERMAN *(right)*, of Boston, consulting engineer and for many years member of the firm of Metcalf & Eddy, specialists in water works, sewerage and waste disposal, was elected to honorary membership in the New England Water Works' Association at its recent 50th Annual Convention in Boston.

Photo—Blank & Stoller

J. H. NEESON, chief of the Bureau of Engineering nad Surveys of the City of Philadelphia, has been chosen as president of the American Society of Municipal Engineers. He entered the city's service in 1906 as assistant superintendent of bridges, and later became chief of the Bureau of Highways. He is past president of the Society of Municipal Engineers of Philadelphia.

D. B. STEINMAN, consulting engineer and member of the firm of Robinson & Steinman, of New York, is now serving as president of the National Council of State Boards of Engineering Examiners, an organization sponsoring the establishment of a national bureau of engineering registration. Dr. Steinman is best known for his work in the field of bridge design and construction which he began as assistant to Gustav Lindenthal on the Hell Gate Bridge over the East River, New York.

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Steel goes up—costs come down when a Universal tac
a steel job. On ten recent steel jobs, Universals erected an ave
of 27 tons per day—at an average cost (erecting and bolting) of $5.16
ton. Bulletin 47 tells more about setting steel faster, about cutting costs lo
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ERECTION CAR
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14 men sink more th four miles of drill h

Above: *One of two trucks, each equipped with ten Worthington Self-feeding Rock Drills, used to drill 3,800 six-ft. holes per 24-hour day on the West Neebish Channel job.* At top left: *Two Worthington Forging Furnaces, installed to maintain the supply of drill steel on this job.*

Four Worthington 10,000 g.p.m. Axiflo Drainage Pumps were used to unwater the channel in preparation for drilling operations. Over a billion gallons of water was pumped in 17 days.

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You may send me: ☐ The complete story of the West Neebish Channel job.
☐ Literature on Worthington Rock Drilling Equipment.
☐ Literature on other Worthington products as follows:

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...than ...hole per day

20 holes every 7 minutes . . . with 14 men instead of 20. That is what the Connolly Contracting Company is accomplishing with Worthington Rock Drills on the job of deepening the West Neebish Channel of the St. Mary's River, which links Lake Superior with Lake Huron.

The channel is 9,400 ft. long, 300 ft. wide. Holes are drilled every 4½ ft. . . . a job that would have been long and tedious if handled by the usual drilling methods.

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Operating without interruption, each truck . . . *drilling ten holes at a setting* . . . progresses at the rate of a move every seven minutes. Together, they sink 3,800 six-ft. holes . . . totaling more than four miles . . . every 24 hours.

This remarkable advancement in rock drilling practice is typical of the helpful service that Worthington renders to contractors and industrial organizations. If *you* have a problem within the scope of the products listed at the right, Worthington engineers will be glad to help you solve it.

The full story of the West Neebish Channel job, with additional illustrations, will be sent at your request. *For convenience, use the coupon at the left.*

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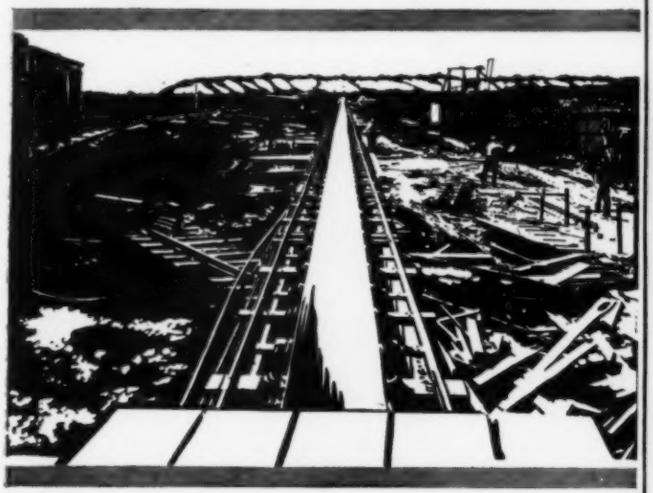

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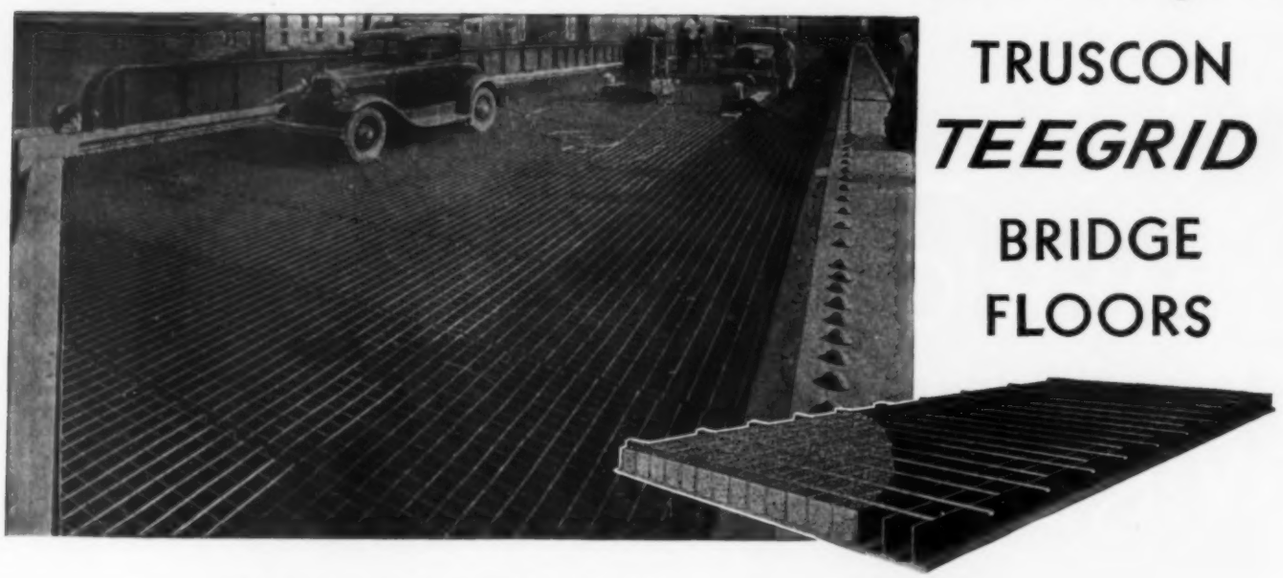
60 East 42nd Street, New York, N. Y.

BATES
WIRE BAR TIES

Distributors in all principal cities

Extra Strength with Minimum Dead Weight!



TRUSCON *TEEGRID* BRIDGE FLOORS

The perfect solution of bridge floor problems. Great strength with minimum dead weight. Simplified, speedy erection. Absolute continuity of material and load distribution. Eliminates field "forms" for concrete and provides a steel-armored wearing surface.

Write for complete data.

TRUSCON STEEL COMPANY, YOUNGSTOWN, OHIO

GEO. A. FULLER COMPANY *does difficult stone setting job on Capitol steps in Washington with* BYERS

HERE'S another prominent Byers' customer. The Geo. A. Fuller Co., contractors, in Washington own this 1 yd. Byers' crane with 60 ft. boom. This project, consisting of carefully setting new steps of Mt. Airy granite on the west approach of the Capitol Building in Washington, was done under the supervision of David Lynn, architect of the U. S. Capitol grounds, and the engineer of construction on the job was P. J. Dalton.

On difficult jobs the name "Byers" stands for profit assurance! For performance! For service! For what you've been wanting in your next shovel or crane! Write now for Byers Golden Jubilee literature on the size of unit you want.

The BYERS MACHINE Co., Ravenna, O.

Improved Sales and Service Throughout the Country

BYERS

RAVENNA OHIO

WHY BYERS' GOLDEN ANNIVERSARY JUBILEE?

Chester Arthur was President of the United States in 1882 when the John F. Byers Machine Company started building excavating equipment.

50 SUCCESSFUL PROGRESSIVE SERVICEABLE YEARS *of* BUILDING EXCAVATING EQUIPMENT

1 The most complete line of fast, sturdy, improved shovels and cranes in Byers' 50 years of making history.

Complete in range of portable sizes from 1 1/4 yd. capacity down to 3/8 yd. with every standard size in between.

2 Greater value, a more liberal service policy, a better assurance of making money under present competition, is offered every purchaser of any Byers' improved shovel or crane.

3 Greater acceptance than ever before of Byers' direct-drive machines as proved by the exceptionally large number chosen in 1931 by leading contractors throughout the United States.

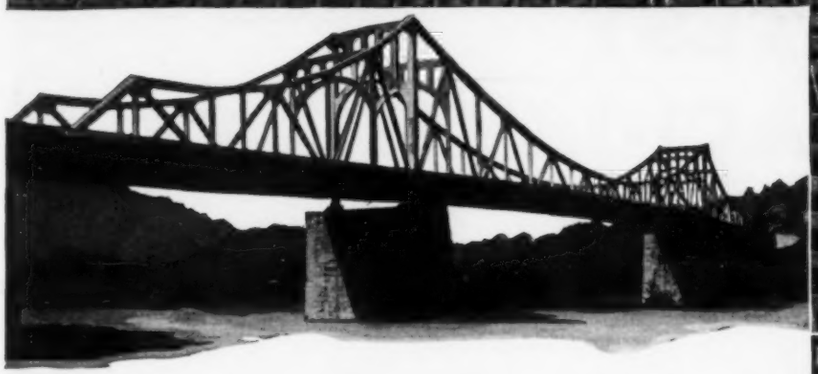
4 Improved sales and service facilities throughout the United States, operated by the most prominent and reliable distributors located in your territory.

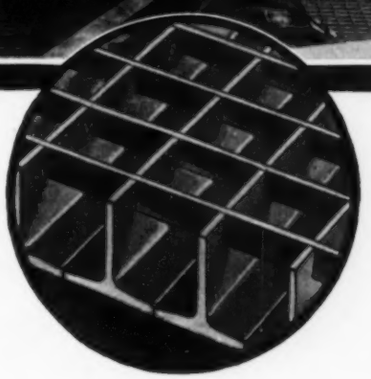
NOW A TIP—

Start the season right. Investigate Byers; choose the size and type of excavating equipment you need. You'll get more for your money.

BYERS MACHINE CO
RAVENNA. OHIO

SHOVELS AND CRANES





T-TRI-LOK Floor
Features New Boston (Pa) Bridge

Strong, permanent, fireproof, light in weight, **T-TRI-LOK** provides an efficient and economical roadway surface which meets all requirements of modern traffic conditions.

T-TRI-LOK is particularly easy to install. Standard units are furnished in widths up to 4 feet and in lengths up to 40 feet. Units are placed directly on bridge stringers and secured by bolting, riveting, welding or clipping. The cells are then filled flush with concrete, preferably vibrated into place, forming an armored concrete, non-skid wearing surface of long life and high efficiency. No forms for concrete are required.

Pictured above is the new Boston Bridge No. 6 over the Youghiogheny River, erected by Fort Pitt Bridge Works, where **T-TRI-LOK** was used with complete satisfaction. Send for the booklet, "**T-TRI-LOK** Bridge Floor Construction."

Carnegie engineers are also at your service.

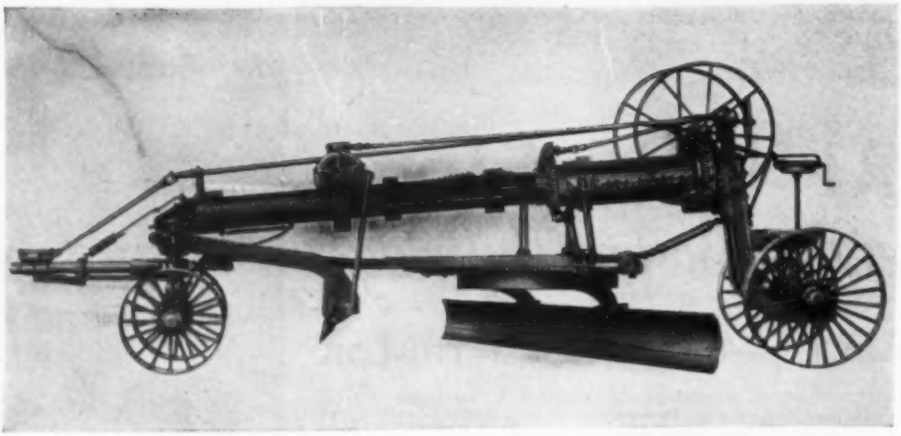
•

CARNEGIE STEEL COMPANY • PITTSBURGH, PA.

Subsidiary of United States Steel Corporation 165

T-TRI-LOK

"WARCO'S" LATEST ACHIEVEMENT



The new WARCO tubular frame PULL TYPE GRADERS are designed to withstand the hardest kind of construction work. They are not "just another line of pull graders" but have exceptional features and will do exceptional work.

The heavy tubular frame placed exactly on the center line of the grader affords the operator an unobstructed view of the blade and being placed high permits the blade to swing high on either side, even to a vertical position.

Draft from the tractor is a direct pull to the moldboard through the moldboard drawbar and extremely heavy circle.

W. A. RIDDELL COMPANY, BUCYRUS, OHIO

POWER and DRAWN GRADERS—WHEELED SCOOPS—CRAWLERS—MIXER and LEVELER UNIT

LOOK TO THIS LINE —

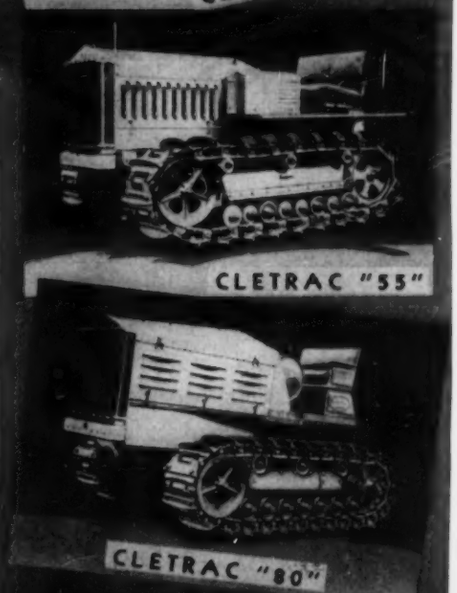
— *when you need* POWER

FIVE TRACTOR SIZES— 15 TO 80 HORSE POWER

IT'S that *extra* performance which Cletrac Crawlers are able to put into a job that makes them outstanding favorites with public officials, engineers and contractors the world over. They have the extra power, extra speed and extra capacity that never fail to show up in extra savings and earnings at the end of a job or a season.

That is why we say, "Turn to the Cletrac line when you need power." It is made up of dependable, capable units that are built for the heavy loads and tough going of your kind of work. Five Cletrac models ranging from 15 to 80 h. p. are yours to choose from — five different sizes to match the power requirements of any equipment or any job.

Let us give you the complete story of these fast, sure-footed, capable crawlers and show you what they offer in efficient, low-cost tractor service. See your local Cletrac distributor— or write direct for full information.



NEW!

— CLETRAC "25"

CLETRAC

CRAWLER TRACTORS

THE CLEVELAND TRACTOR COMPANY

19323 Euclid Avenue Cleveland, Ohio

ONE

MILLION YARDS--

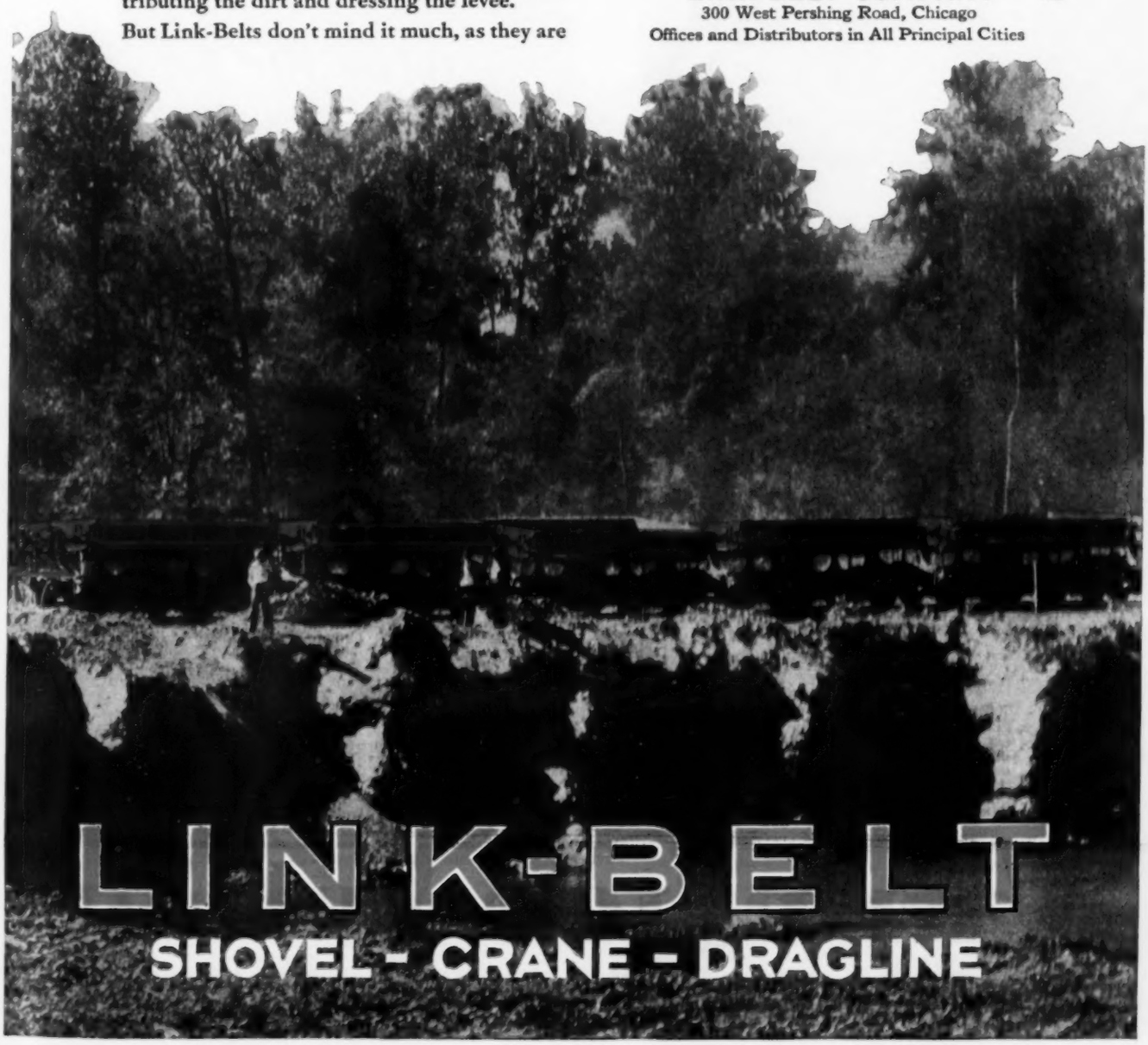
Handled by two Link-Belt K-55s in 4 months

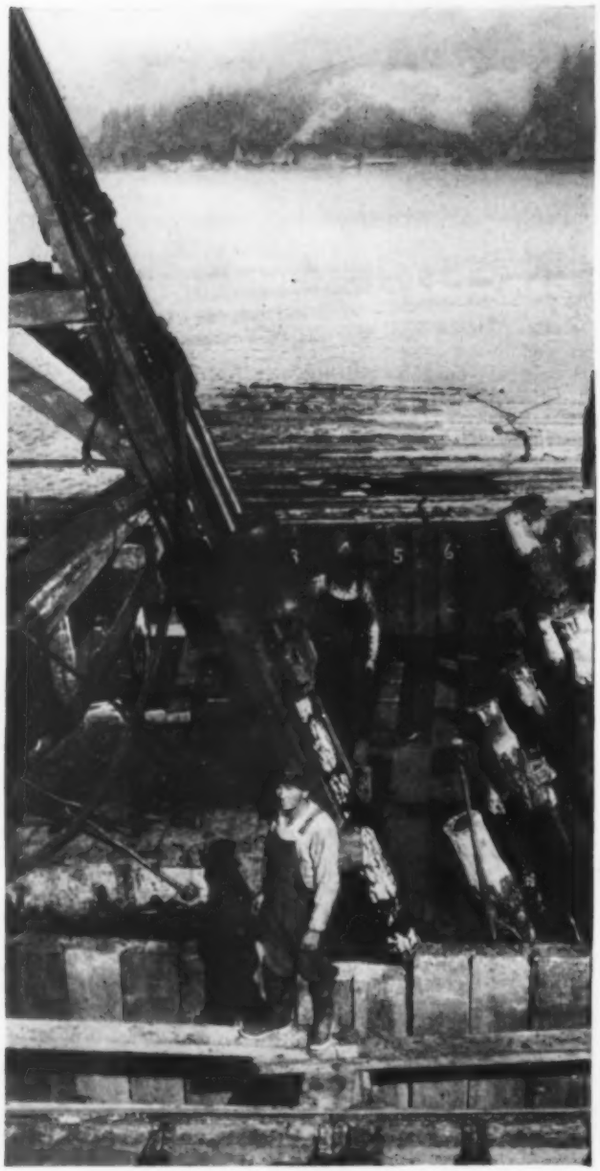
PERFORMING in continuous day and night service—that is what two Link-Belt type K-55 draglines have been doing for L. A. Wilson & Co., Inc., Ottawa, Ill., for the last 4 months, on levee construction work near Sherard, Miss. In this time they have dug and loaded 1,000,000 cubic yards of dirt from borrow pit to the 12-yd. dump cars in which it is hauled to the levee. Three of their other Link-Belts are also at work on this job, distributing the dirt and dressing the levee.

But Link-Belts don't mind it much, as they are built for just such grueling, continuous, day and night service . . . for the tough job . . . and for work where fast, dependable, low-cost performance means everything.

It would be a pleasure to tell you more about the Link-Belt line of heavy-duty shovels, cranes and draglines, which range from ¾ to 3 cu. yds. capacity. Send for Catalog No. 1095.

LINK-BELT COMPANY 4480
300 West Pershing Road, Chicago
Offices and Distributors in All Principal Cities





Batter Piles, too, *are driven home with the* "VULCAN PUNCH"

The Vulcan principle of heavy mass-low velocity applies equally well to the driving of batter piles as it does to vertical driving. Little of the true Vulcan Punch is lost, and the same high percentage of effective energy is obtained.

The heavy Vulcan Ram striking at low velocity produces maximum penetration per blow. Inertia is quickly overcome, piles are driven with a minimum number of blows. Examine the heads of Warrington-Vulcan driven piles. Notice their smooth, unbroken condition whether wood or concrete.

Quicker driving with economy of energy and time always accompany the Warrington-Vulcan. That's why they are preferred by contractors and engineers everywhere.

VULCAN IRON WORKS
327 No. Irving Avenue, Chicago, Illinois

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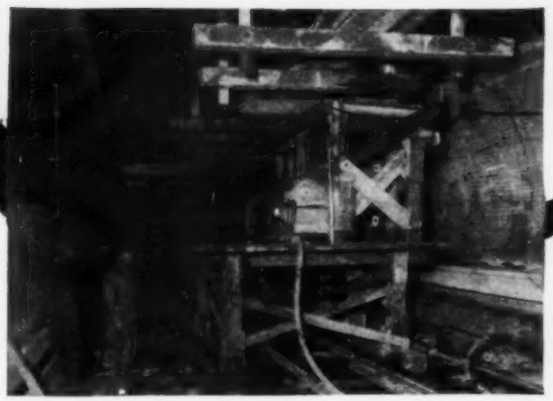
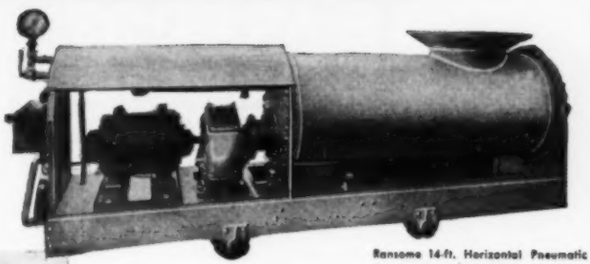
Warrington-Vulcan PILE HAMMERS

the STORY of Ransome PNEUMATIC PLACERS



Placing roof of Vehicular Tunnel—New York City to Jersey City.



Ransome 14-ft. Horizontal Pneumatic Placer. Capacity 14 cubic feet per shot.

Ransome Pneumatic Grout Mixer and Placer.

Every contractor and every engineer who has a problem of placing concrete in subways, railroad tunnels, water tunnels, sewers or mines should have a copy of our new illustrated 24-page Bulletin No. 105 B.

It tells the advantages of using the Ransome Pneumatic Concrete Placer and the Ransome Pneumatic Grout Mixer and Placer—lists important jobs—contains air requirements, outputs and other operating data. It is a hand book on placing concrete and grout by compressed air.

Send for a free copy—and mail the coupon.

FILL OUT AND MAIL THIS COUPON FOR DETAILED INFORMATION ON SPECIFIC JOBS

1. Length of tunnel, end to end .....
2. Length between shafts .....
3. Height and width in rough .....
4. Height and width, finished section .....
5. Minimum thickness of concrete and point at which it is found .....
6. Amount and location of reinforcing .....
7. Is tunnel in rock or earth? .....
8. Will tunnel excavation be completed before lining? .....
9. If mucking, while lining, must muck cars pass through forms? .....
10. If in soft ground, will concreting follow up behind heading? .....

Estimated distances .....

11. Length of form used, steel or wood, and print of same .....
12. Type of concrete cars. Height and width .....
13. Locomotive (if used). Height and width .....
14. Size and kind of gravel or stone used .....
15. Compressed air available in cubic feet per minute .....
16. Will drills, air hammers, etc., operate from this supply when blowing concrete? .....
17. Gauge and size of track used .....
18. Electric current available for operating motor on placer .....
19. How much yardage to be placed by air is involved? .....
20. What length of time allowed for placing this yardage? .....
21. Make sketch showing measurements mentioned in 3, 4, 5 and 6 .....
22. For whom is job being done? .....

Location of job .....

Name .....

Company .....

Position .....

Address .....

City ..... State .....

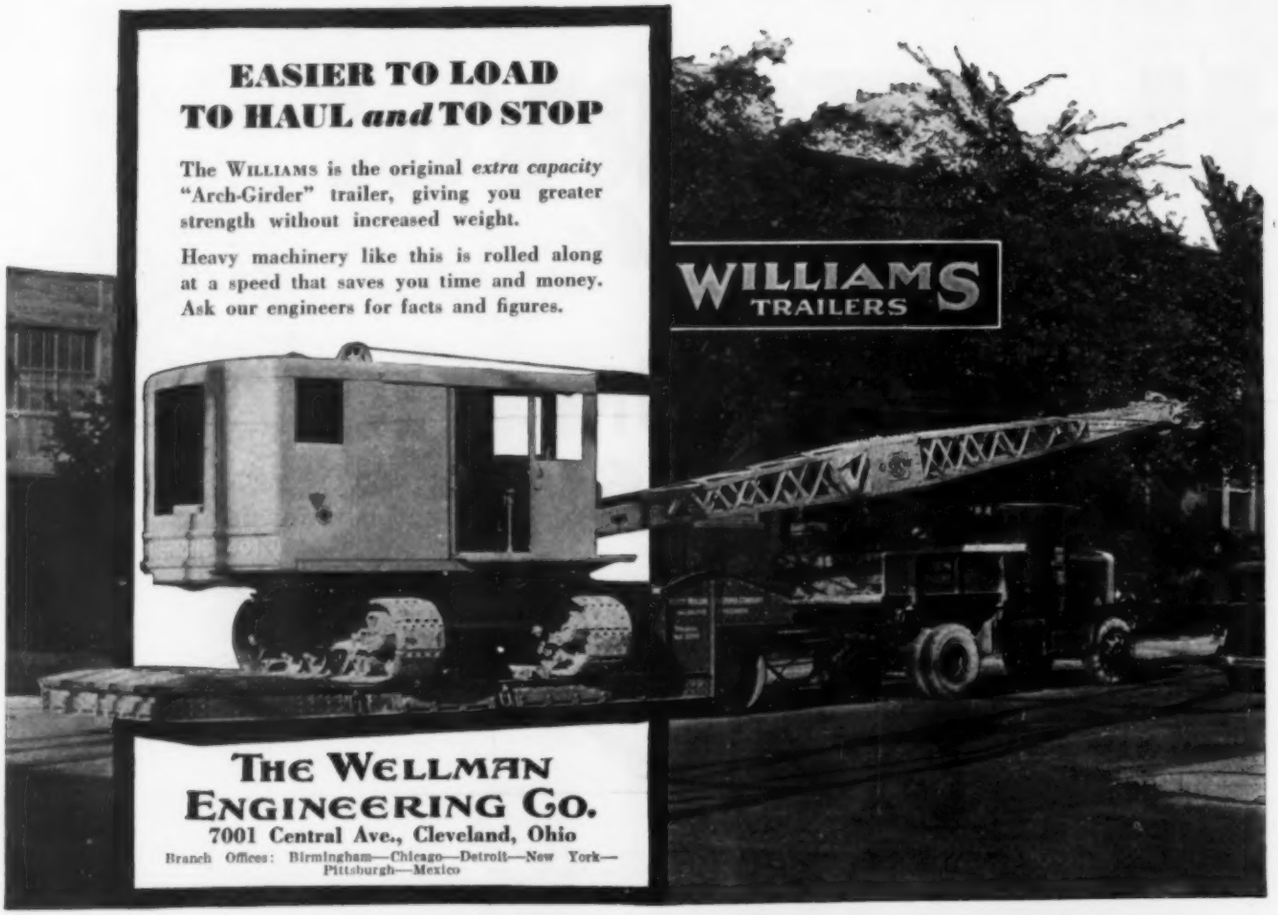
Ransome Concrete Machinery Company

1850—Service for 82 Years—1932

EASIER TO LOAD TO HAUL *and* TO STOP

The WILLIAMS is the original *extra capacity* "Arch-Girder" trailer, giving you greater strength without increased weight.

Heavy machinery like this is rolled along at a speed that saves you time and money. Ask our engineers for facts and figures.



THE WELLMAN ENGINEERING CO.
7001 Central Ave., Cleveland, Ohio
Branch Offices: Birmingham—Chicago—Detroit—New York—Pittsburgh—Mexico

BAKER TWIN CYLINDER HYDRAULIC BULLDOZERS

Upper View - Backfilling trench at Evanston Ill by Public Service Co. of Northern Illinois
Lower View - Leveling fill on big road job. Contractors, Darrow & Barren, Waukegan, Illinois

They are solving the backfilling and earth spreading problem for contractors by using entirely new principles. Light weight with tremendous strength — floating blade — perfect balance — no side strain on tracks—wide range of lift both above and below tracks—instant, smooth control — quick lift — clear draw bar.

Baker Bulldozers are built up to the high standard you have a right to expect from Baker Products. Their unfailing performance on tough jobs, working continuously day and night has proved that they have the stability for your hardest assignment.

Bulldozer Bulletin gives details. Send for it.

The Baker Manufacturing Co.
568 Stanford Ave., Springfield, Ill.

BAKER MANEY SCRAPERS□ BULLDOZERS□ SNOW PLOWS□ BACKFILLERS□
ROAD ROOTERS□ ROTARY SCRAPERS□ ROAD MAINTAINERS□

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TRACTOR EQUIPMENT
EARTH MOVING-ROAD MAINTENANCE-SNOW REMOVAL

Infaration*

*The most essential quality in a bituminous road material . . . . . .

See next page

Infaration*

A section of Lincoln Memorial Drive, Milwaukee, Wis., surfaced with Tarmac. This surface has Infaration.

Q. What makes some roads skid resistant?
A. . . . . Infaration!

Q. What keeps certain types of bituminous roads from waving or shoving?
A. . . . . Infaration!

Q. What enables some bituminous binders to penetrate completely and bind permanently even when aggregate is not clean?
A. . . . . Infaration!

*Tarmac
has **Infaration**

***Infaration is the most essential quality in a bituminous road material . . .**

Send for facts about Infaration . . and the simple tests which illustrate it.

KOPPERS PRODUCTS CO.

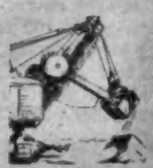
WIRE ROPE MAY BE COSTING YOU TOO MUCH MONEY..

THOUSANDS OF TRU-LAY USERS ARE SAVING WIRE ROPE MONEY

255% INCREASED SERVICE

32 months service with Tru-Lay as compared with 9 months service with ordinary (non-preformed) wire rope—on a Gantry Crane operated by a New Jersey Lumber Company.

113% INCREASED SERVICE



A Mining Company in Quebec reports 204,680 tons of rock and waste handled with Tru-Lay—as compared with 95,940 tons with ordinary (non-preformed) wire rope.

104% INCREASED SERVICE

Rotary Drilling is a severe test of wire rope. An Oklahoma Drilling Company reports 10,000 feet drilled with Tru-Lay, 4,900 feet with ordinary (non-preformed) wire rope.

133% INCREASED SERVICE

Ordinary (non-preformed) wire rope averaged, in this New York Office Building, 12 months of service. The first Tru-Lay Rope was installed during November, 1925. After 28 months of service the rope was removed for inspection. All of the wires were found in excellent condition. The test for strength was 19,500 lbs. as against a catalogue strength of 19,000 lbs.

These are a few recent service reports, chosen at random from our files. Names will be given upon request.

■ "All wire rope is alike" no longer serves as a buying guide. Industry is checking up on wire rope value . . . on work delivered per dollar. This is the reason for the almost universal acceptance of Tru-Lay Preformed Wire Rope.

YOU CAN GET 30% TO 300% INCREASED SERVICE WITH TRU-LAY

Increased service of 30% to 300% with Tru-Lay Preformed Wire Rope is backed up by facts . . . by voluntary service reports covering nearly every operating use. The amount of increased service depends upon the type of equipment and nature of the service.

THE REASON IS ELIMINATION OF INTERNAL STRESS

HOLD YOUR HANDS LIKE THIS . . .
Hold your hands in this position. Note how lightly your fingers rest against each other. This demonstrates how Tru-Lay strands and wires rest against each other . . . without straightening out effort and without internal stress.

Internal stress in wire rope causes early fatigue and premature failure. In Tru-Lay Preformed Wire Rope internal stress is eliminated because wires and strands are helically shaped, so they fit naturally and unstressed. They lie in position relaxed so that each wire and strand is free to carry its share of the load.

Wires and strands of ordinary (non-preformed) wire rope are held in position—under force. That is why you have to seize the end to prevent the wires and strands from straightening out and flying apart as the internal stress is released.

Tru-Lay is easier to handle, resists kinking and wraps snugly on the drum or sheave groove. Write, without obligation, for complete facts about Tru-Lay Preformed Wire Rope.

SEND FOR THIS COMPLETE STORY....

Let us send you, or the man in your organization responsible for wire rope costs, a copy of "Why Preformed Wire Rope." Write for it on your business letterhead.

AMERICAN CABLE COMPANY, Inc.
230 Park Avenue — *District Offices:* — NEW YORK CITY
Atlanta, Chicago, Detroit, Philadelphia, Pittsburgh, Denver, Tulsa, San Francisco

The following Canadian Manufacturers have been licensed to manufacture Preformed Wire Rope under the American Cable Company's Patents:
Dominion Wire Rope Co., Ltd. — Canada Wire & Cable Co., Ltd.
Anglo-Canadian Wire Rope Co., Ltd. — B. Greening Wire Co., Ltd.

ACCO — *An Associate Company of the American Chain Company, Inc.*

TRU-LAY PREFORMED WIRE ROPE
30% to 300% Increased Service [*Depending upon the character of the service and type of equipment*

Practical facts on every phase of building construction!

HERE is a Library of books that are packed to the covers with the best plans and methods for speeding up production, saving materials and labor, and cutting costs. These six books cover every phase of practical construction work from estimating building costs to the selling of construction service—from plan reading and quantity surveying to practical job management. With the aid of these books the contractor can get business in these dull times by learning how to make savings, and through them being able to make lower bids. The construction superintendent can learn how to keep costs down, which insures his job these days.

The Dingman Building Contractors' Library

The Dingman books have won a wide reputation among builders and building contractors for their sound, practical and easy-to-understand discussion of building construction work. All of the material has been drawn from actual practice.

This library is intended for —

[1] The building contractor who wants a handy reference set that will give him almost instantly a ready answer to most of the problems that come up in the course of the day's work.

[2] The young men in the building industry who intend to make the business of construction their life work, and who want the kind of guidance that will aid them to climb to the top.

[3] Everyone in the building industry who wants to keep his job by increasing his usefulness and efficiency.

Each one of the volumes in this set is a complete handbook on some important subject. Sturdily bound and pocket size, it will go right "on the job" with you for immediate consultation.

Practical data is given on analyzing a construction job into its component parts—estimating the costs of labor, haulage, equipment, materials, etc. —plan reading and determining quantities from specifications—personnel management—successful supervision of every building operation—efficient and economical business methods—office procedure such as accounting banking, purchasing, etc.—advertising and selling methods for contracting service—and a complete data book of tables, forms and calculations most frequently used by the builder.

Free Examination—Small monthly payments

Without a cent of expense—without any obligation on your part—you may examine the Dingman Building Contractors' Library for 10 days and determine its value for yourself. Try the books out on your everyday problems—make them prove their worth to you. Unless they meet every test send them back at our expense. If the books prove satisfactory and you decide to keep them, pay only $1.50 in ten days and then $2.00 a month for six months.

Every contractor and builder, every architect and engineer, every student and executive, who is seeking practical help on the everyday problems connected with building construction work should have this valuable reference library.

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FREE EXAMINATION COUPON

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You may send me for 10 days' free examination, the new six-volume Dingman BUILDING CONTRACTORS' LIBRARY. I agree either to return the books at the end of 10 days or send a first payment of $1.50 then and $2.00 a month for six months.

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Wherever piping or conduit is to be placed underground Hydrauger will do the job with greater speed and economy. Pavement cutting is avoided almost entirely. Hydrauger bores a clean, open hole through which pipe can be run without pushing or jacking. Target-control combined with rigid boring-bars assures accuracy at distances up to 100 feet. Bores 2½ to 10½ inch holes at speeds of one or two feet per minute depending on formation. Write for your copy of latest Bulletin now!

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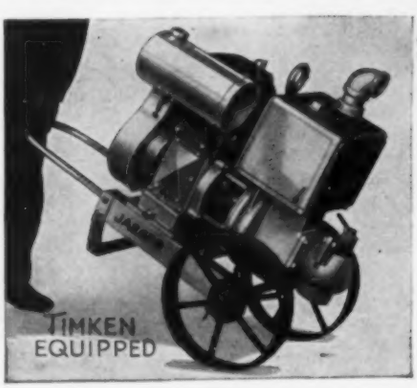
"The Mechanical Gopher"

Here it is...JAEGER 10,000 GALLON, 2" SELF-PRIMING CENTRIFUGAL, only



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Self-priming in 10 to 50 seconds.

Holds prime.

Lift over 25 feet, head up to 55 feet.

Self-adjusting gland.

Big water passages.

One-man mounting.

2—2½ h.p., 4 cycle engine or electric power.

Here's your one man, portable, 100% automatic priming centrifugal pump for the job up to 10,000 g. p. h., for the job up to 55 ft. head, for keeping a hole dry for less money than it ever cost before. Write today for catalog.

THE JAEGER MACHINE COMPANY
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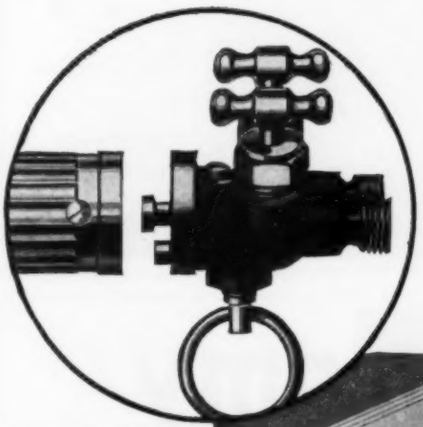
GET OUR PRICES ON MIXERS, PUMPS AND HOISTS

Who...

MAKES PREST-O-WELD BLOWPIPES ?



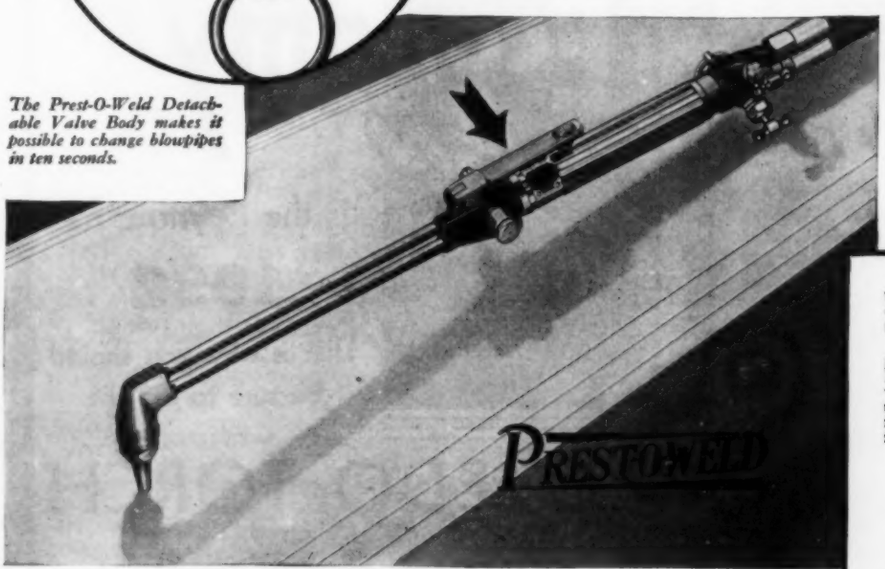
The Prest-O-Weld Detachable Valve Body makes it possible to change blowpipes in ten seconds.

PREST-O-WELD Blowpipes are made by Oxweld Acetylene Company, the largest manufacturer of oxy-acetylene welding and cutting equipment. In buying Prest-O-Weld Blowpipes, you share the advantages this company is able to give you as a result of its leadership in the welding and cutting field.

Through the Union Carbide and Carbon Research Laboratories, Inc., Prest-O-Weld can draw upon the best engineering data and research in designing or improving its blowpipes. It has first claim to the keenest engineering brains in the welding industry. It has the means to experiment with every possible way of making better welding and cutting equipment.

When you buy Prest-O-Weld, you get apparatus that is scientifically accurate in design, extremely low in gas consumption, rugged in construction, and light and comfortable to handle.

Your jobber will be glad to show these and other advantages of Prest-O-Weld Blowpipes to you.



The new Prest-O-Weld Type C-105 Cutting Blowpipe, for all cutting up to 12 in., is equipped with the Prest-O-Weld Detachable Valve Body.

This light, well-balanced blowpipe is especially designed to resist rough handling. Its patented conical nozzle protects the seat when the nozzle is dropped. The head, cutting valve body, and lever are pressure forged for added strength. A 75 deg. angle head is furnished as standard.

Prest-O-Weld Type C-105 Cutting Blowpipe complete with 4 nozzles, lighter and wrench..... $42.00

Prest-O-Weld Type C-105 handle assembly with 4 nozzles, lighter and wrench (same as above but without valve body)..... $34.00

Prices slightly higher west of Rocky Mountains.

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Unit of Union Carbide and Carbon Corporation

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Forward!

No more guessing

A Fairbanks Wheelbarrow Scale "on the job."

Concrete Mixing Advances with the Fairbanks Wheelbarrow Scales

The weighing of aggregate is a highly progressive step forward in the mixing of concrete. Accomplishing all the desired results of scientific design by engineers' formulae is made possible by the use of Fairbanks Wheelbarrow Scales. With them time and labor are saved, quality of concrete is safe-guarded, and absolute uniformity is assured. Hundreds of contractors are using these scales and meeting rigid specifications without increasing labor cost of mixing. There are three types of these scales. No obligation attends your inquiry for further details.

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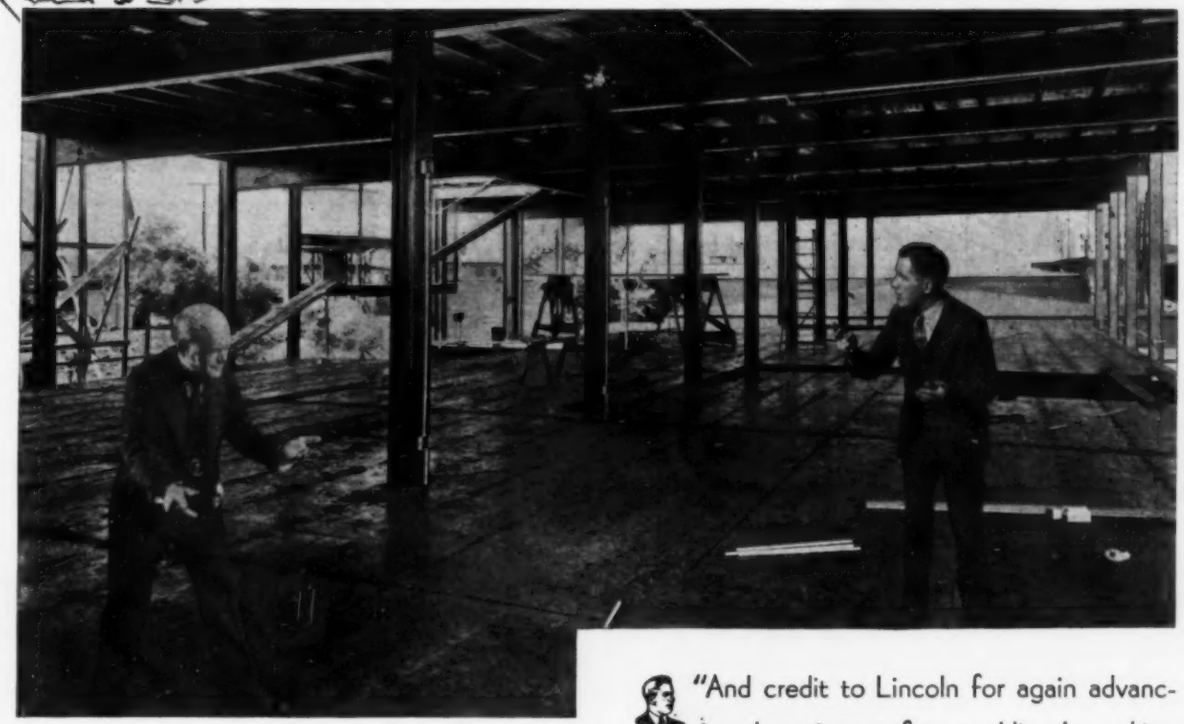

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"That means lighter framework . . . a savings in tonnage.

"By arc welding the steel plates to the supporting beams they get a floor that acts as single unit stiffening the entire structure.

"You have to give credit to arc welding for advancing the science of building construction."

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"This battledeck-type floor was welded by the shielded arc with 'Fleetweld' electrodes and a 'Stable-Arc' welder.

"Such floors can also be welded automatically by the shielded arc process with Lincoln's 'Electronic Tornado.'

"You'll find the welding equipment used on most construction jobs, whether buildings or bridges. pipe lines or storage tanks, bears the name . . .

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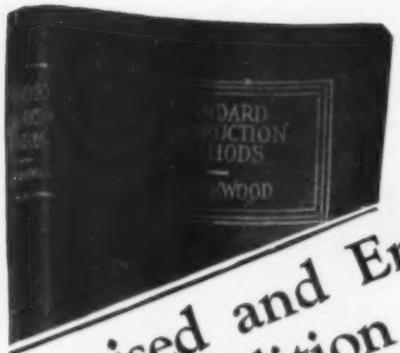

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Increase Shovel Yardage 10%

—Trip the Bucket with the U. S. A. Dipper Trip

Replace the old rope-pulling, back breaking method with this new U. S. A. Universal Semi-Automatic Dipper Trip. A twist of the wrist, and the bucket is tripped—instantly! No tugging at a rope. The operator doesn't leave his controls. And there's no lagging toward the end of the day. Speedy—positive—increases yardage 10%. Made for all standard types of power shovels. The U. S. A. Dipper trip is compact and easily attached to any make of shovel.

Invented and manufactured by a man *who ran shovels for 15 years*—who saw the waste of rope-pulling and who licked it with this device.

U. S. A. Dipper Trips are optional at extra cost on Marion, P.&H. and Byers Shovels. Other shovel manufacturers are also installing these on new shovels when requested by the buyer. Specify U. S. A. Dipper Trip on your next shovel, and get the extra 10% yardage!

Get complete facts from bulletin—write for it.

Send for Bulletin

MORIN MFG. CO.
Holyoke, Mass.

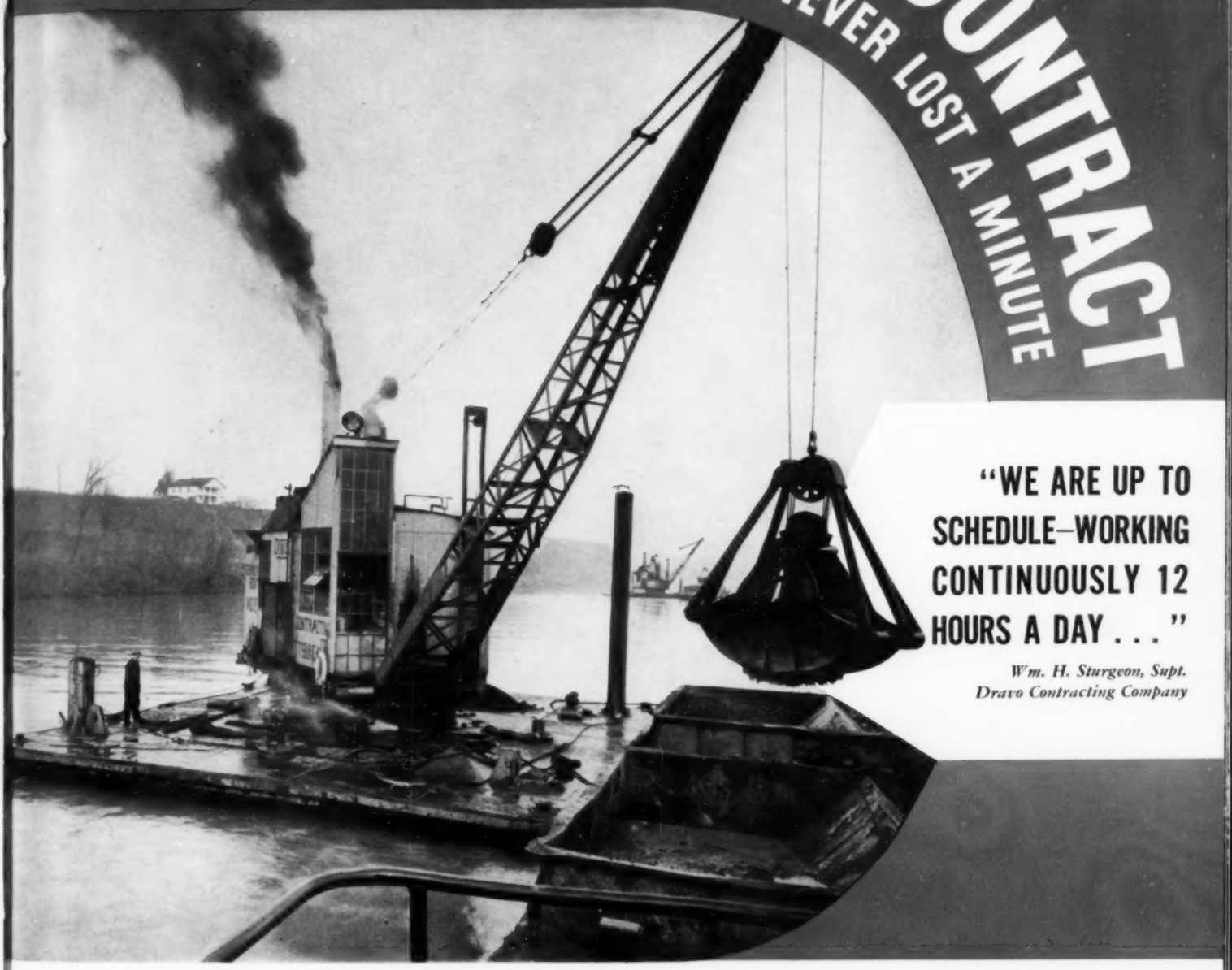
Used and Surplus Equipment

INDIVIDUAL items of used equipment, or surplus new equipment, or complete plants, are disposed of (and found) through advertising in the *Searchlight* Section of this paper.

This is the section which so effectively aided the Government in selling the many millions of dollars worth of surplus material and equipment accumulated during the war without disturbing the market.

"SEARCHLIGHT"

TOUGH TIME CONTRACT
AND NEVER LOST A MINUTE



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Wm. H. Sturgeon, Supt.
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"The old river bottom sure comes up when these buckets get to work on it" remarked the Superintendent on this Ohio River Channel excavating job, at Belleville, W. Va. Two heavy duty Owen Clamshell Buckets are helping the Dravo Contracting Company keep to schedule on this important time contract. Much of the work is in hard-pan gravel, not an easy job for buckets—and they have to take plenty of punishment. "Boulders from 500 lbs. to 7 tons brought up—exceptional loads in hard river bottom digging—no time lost." These are statements, made on the job, that vouch for the rugged and efficient qualities of Owen Buckets in action. They are "coming through" on time without trouble on a tough job. This is an Owen's way of satisfying the Dravo Contracting Company. It is the usual satisfying way of an Owen Clamshell Bucket.

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6023 Breakwater Avenue, Cleveland, Ohio

Owen Buckets

A MOUTHFUL AT EVERY BITE®

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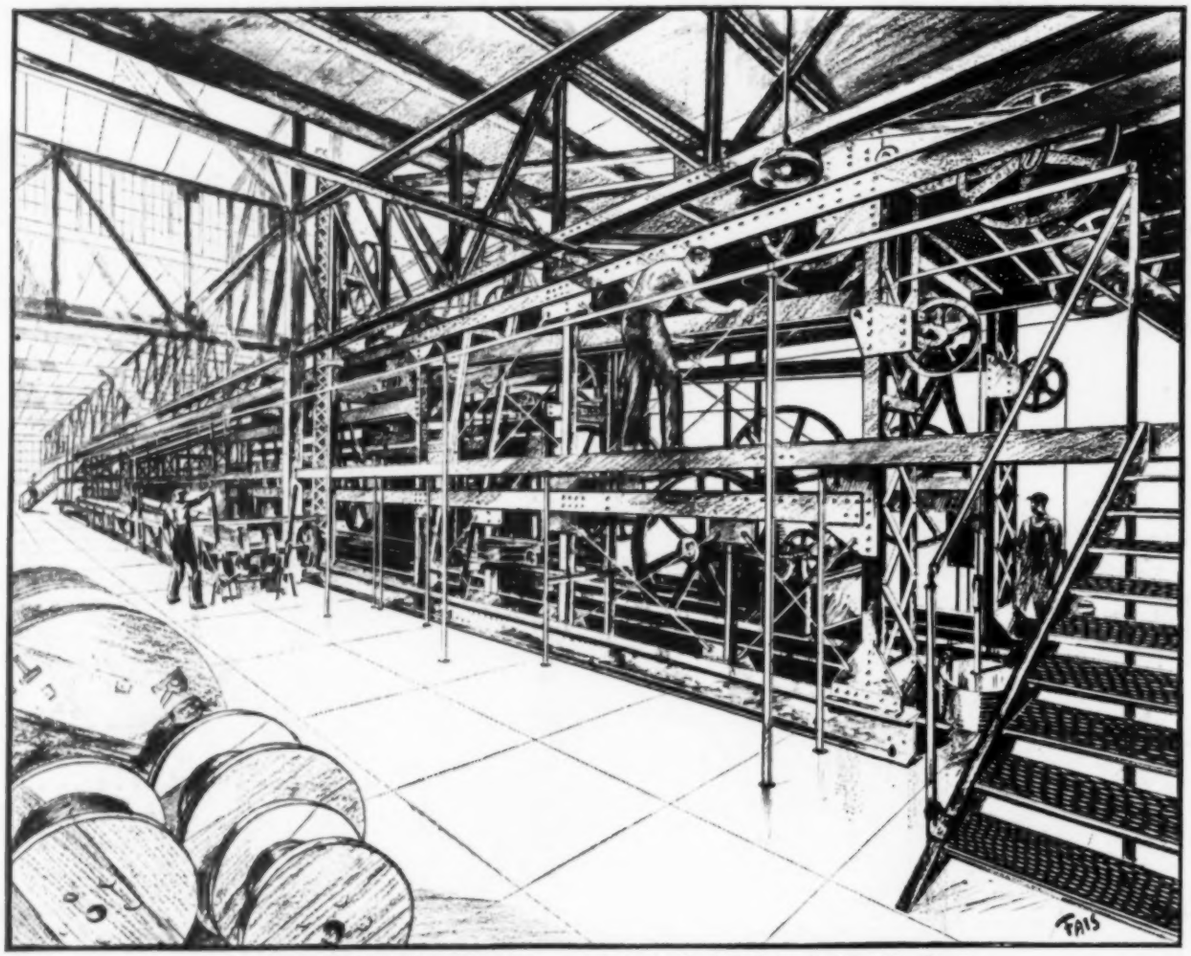

No. 14 of a series of advertisements on "How Superlative Quality is Built into Roebling Wire Rope". Illustrated is the world's largest and most highly developed wire rope fatigue testing machine.

Never-ending study of Wire Rope qualities

In its determination to make wire rope of utmost stamina, safety and service economy, Roebling has explored every possibility of developing and improving this product. Regardless of cost, full advantage has been taken of every opportunity.

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Shown above, for example, is the world's largest wire rope fatigue machine, developed by Roebling exclusively for their own study of rope characteristics. With this machine is carried on a never-ending search into the wearing and fatigue qualities of wire rope under various bending and tension conditions.

One of several similar fatigue machines built by Roebling at various times, the unit illustrated is not only the largest and most elaborate in existence but is by far the most highly developed. It represents years of experimenting and refining, and an investment of many thousands of dollars.

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ROEBLING **WIRE ROPE**

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